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Region 2 RAC2
Remedial Action Contract

Revised Final Work Plan Volume 1

Cabo Rojo Groundwater Contamination Site

Remedial Investigation/Feasibility Study

Cabo Rojo, Puerto Rico

October 15, 2012

CDM Smith

REMEDIAL ACTION CONTRACT
EPA REGION 2

REVISED FINAL WORK PLAN
VOLUME 1

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
CABO ROJO GROUNDWATER CONTAMINATION SITE
CABO ROJO, PUERTO RICO

Work Assignment No.: 045-RICO-A244

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Acronyms

amsl	above mean sea level
ARARs	Applicable or Relevant and Appropriate Requirements
ASC	Analytical Services Coordinator
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BMP	best management practices
BTAG	biological technical assistance group
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CFR	Code of Federal Regulations
CIP	Community Involvement Plan
cis-1,2-DCE	cis-1,2-dichloroethene
CLASS	Contract Laboratory Analytical Support Services
CLP	Contract Laboratory Program
Cm^3	cubic centimeter
CO	Contracting Officer
COPC	chemical of potential concern
CRPDC	Cabo Rojo Professional Dry Cleaners
CRQL	contract required detection limit
CS	Contract Specialist
CSM	conceptual site model
CTE	Central Tendency Exposure
DESA	Division of Environmental Science and Assessment
DFDC	D'Elegant Fantastic Dry Cleaners
DNAPL	dense non-aqueous phase liquid
DPT	Direct push technology
DQI	Data Quality Indicator
DQO	Data Quality Objective
DQTL	Data Quality Task Leader
ECD	electron capture detector
EDD	electronic data deliverable
EDM	EQuIS Data Manager
EDP	EQuIS data processor
Eh	Oxidation-Reduction Potential
EPA	United States Environmental Protection Agency
EPC	Exposure point concentration
EQP	Extasy Q Prints
EQuIS	Environmental Quality Information Systems
ERAGS	Ecological Risk Assessment Guidance for Superfund
ESAT	Environmental Services Assistance Team
F	Fahrenheit
FAM	Finance and Administration Manager
FASTAC	Field and Analytical Services Teaming Advisory Committee
FCR	field change request
FS	feasibility study
FSTM	feasibility study task manager
FTL	Field Team Leader
ft	feet

ft^2/d	square feet/day
gal/min/ft	gallons per minute per foot
GC	gas chromatograph
GIS	Geographic Information System
GPS	Global Positioning System
gpm	gallons per minute
H&S	health and safety
HHRA	Human Health Risk Assessment
HI	Hazard Index
HPFM	heat pulse flow meter
HQ	Hazard Quotient
HRS	Hazard Ranking System
HSP	Health and Safety Plan
ID	inner diameter
IDW	Investigation Derived Waste
IFB	Invitation for Bid
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
Km	kilometer
LEL	Lowest effects level
MCL	Maximum Contaminant Level
MDL	Method detection limit
MEE	methane/ethane/ethene
mg/kg	milligrams per kilogram
mL	milliliter
MNA	monitored natural attenuation
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
NELAP	National Environmental Laboratory Accreditation Program
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NPL	National Priority List
OSWER	Office of Solid Waste and Emergency Response
PAR	Pathway Analysis Report
PCE	tetrachloroethene
PG	project geologist
PGM	program manager
PID	photoionization detector
PLOE	professional level of effort
PM	project manager
PO	Project Officer
POTW	Publicly Owned Treatment Works
ppbv	parts per billion by volume
PPRTV	Provisional Peer Reviewed Toxicity Values
PRDNER	Puerto Rico Department of Natural and Environmental Resources
PRIDCO	Puerto Rico Industrial Development Company
PRASA	Puerto Rico Aqueduct and Sewer Authority
PRDOH	Puerto Rico Department of Health
PREQB	Puerto Rico Environmental Quality Board
PSA	Potential Source Area

PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAC	Quality Assurance Coordinator
QAD	Quality Assurance Director
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
RAC	Remedial Action Contract
RACMIS	RAC Management Information System
RAGS	Risk Assessment Guidance for Superfund
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RFP	request for proposal
RITM	remedial investigation task manager
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure
ROD	Record of Decision
RPM	Remedial Project Manager
RQAC	Regional Quality Assurance Coordinator
RQD	rock quality designation
RSCC	Regional Sample Control Center
RSL	regional screening level
SDC	Serrano II Dry Cleaners
SDI	Site Discovery Initiative
SEL	severe effects limit
SF	slope factor
SLERA	Screening Level Ecological Risk Assessment
SMO	Sample Management Office
SMDP	scientific management decision point
SOP	Standard Operating Procedures
SOW	Statement of Work
TAL	Target Analyte List
TBC	"To Be Considered"
TCE	trichloroethene
TCL	Target Compound List
TCP	Terminale de Carros Publicos
TDS	Total dissolved solids
the site	the Cabo Rojo Groundwater Contamination Site
TKN	total Kjehldahl nitrogen
TOC	total organic carbon
TRC	Technical Review Committee
trans-1,2-DCE	trans-1,2-dichloroethene
TSS	total suspended solids
TSCA	Toxic Substances Control Act
UCL	Upper Confidence Limit
UFP	Uniform Federal Policy
USC	United States Code
USGS	United States Geological Survey
UV	ultraviolet

VOA	volatile organic analyte
VOC	volatile organic compound
µg/kg	microgram/kilogram
µg/L	microgram/litre
1,1-DCE	1,1-dichloroethene

Section 1 Introduction

CDM Federal Programs Corporation (CDM Smith) received Work Assignment 045-RICO-A244 under the Remedial Action Contract (RAC) 2, Region 2 to conduct a remedial investigation/feasibility study (RI/FS) for the United States Environmental Protection Agency (EPA), Region 2 at the Cabo Rojo Groundwater Contamination site (the site) located in Cabo Rojo, Puerto Rico. The purpose of this work assignment is to evaluate the nature and extent of groundwater contamination defined in the EPA Statement of Work (SOW) as a groundwater plume with no identified source(s) of contamination. The media to be investigated during the RI include groundwater and soil. In addition, surface water and sediment also may be investigated as part of the RI. Data collected during the field investigations will be used to prepare an RI Report, a Baseline Human Health Risk Assessment (HHRA), a Screening Level Ecological Risk Assessment (SLERA), and a Feasibility Study (FS).

The RI will focus on collecting adequate data to characterize the nature and extent of contamination in site media and providing adequate data to assess the risk to human health and the environment. The sampling approach is discussed in Section 3. A Quality Assurance Project Plan (QAPP) detailing sample and analytical requirements for the field investigation and a health and safety plan (HSP) will be submitted separately.

Preparation of an HHRA is an optional task. If directed by EPA, the HHRA will be prepared to evaluate the risk from exposure to contaminated media. The HHRA will be conducted in accordance with EPA's Risk Assessment Guidance for Superfund (RAGS). Section 3.7 describes the approach to the HHRA.

Preparation of a SLERA is an optional task. If directed by EPA, a SLERA will be prepared in accordance with EPA's Ecological Risk Assessment Guidance for Superfund (ERAGS), Process for Designing and Conducting Risk Assessments (EPA 1997c). Section 3.7 of this work plan describes the approach to the SLERA.

The FS will be completed in accordance with EPA guidance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) "Interim Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA 1988), or the most recent EPA FS guidance document. The FS will develop and screen a full range of remedial alternatives and provide a detailed analysis of selected alternatives. Sections 3.10 through 3.12 describe the approach to development of remedial technologies and alternatives, and the FS.

1.1 Site Location and Description

The site is located in the Bajura ward in the municipality of Cabo Rojo in southwestern Puerto Rico. Figures 1-1 and 1-2 provide a site location map and a site map, respectively. Cabo Rojo is serviced by the Cabo Rojo Urbano public water system which is maintained by the Puerto Rico Aqueduct and Sewer Authority (PRASA). The system is supplied by six wells (Hacienda La Margarita, Cabo Rojo 1, Cabo Rojo 2, Cabo Rojo 3, Club de Leones, and Ana Maria) and one surface water source which serves an estimated population of 46,911 people. The Ana Maria well acts as an independent system which serves approximately 1,856 people. The Ana Maria and Club de Leones wells are located at Pueblo Norte and Bajura wards, respectively. The Ana Maria and Club de Leones wells are currently active with volatile organic compound (VOC) detections at concentrations below federal maximum contaminant levels (MCLs). The site is currently defined as a groundwater plume with no identified source(s) of contamination. Groundwater samples collected from the Cabo Rojo Urbano public water system from 2004 to 2010 indicated that chlorinated solvents tetrachloroethene (PCE) and trichloroethene (TCE) were detected in several of the wells. Details are presented in Sections 1.2 and 1.3.

On March 10, 2011, EPA listed the site on the National Priorities List (NPL) because the groundwater contamination plume lies within a designated Wellhead Protection Area and based on the groundwater mitigation pathway score from the Hazardous Ranking System (HRS) document (EPA 2010).

1.2 Site History

This section summarizes the site history and is based primarily on information provided in the HRS document (EPA 2010), documentation provided by EPA as part of a soil vapor investigation draft report (EPA 2011), the Agency for Toxic Substances and Disease Registry (ASTDR) Public Health Assessment released for public comment in October 2011, and recent well data provided by EPA. Table 1-1 summarizes recent and historical analytical results for the Cabo Rojo public supply wells and Table 1-2 summaries the well construction information that is available. Figures 1-1 and 1-2 show well locations.

From 2004 through 2005, PCE and TCE were detected in samples collected at the Hacienda La Margarita well and on numerous occasions in samples collected from the Ana Maria well from 2002 to 2006. PCE was detected in groundwater samples from the Ana Maria well at concentrations ranging from 1.8 micrograms per liter (µg/L) to 4.0 µg/L and TCE was detected at concentrations ranging from 0.5 µg/L to 1.6 µg/L, both below the MCL of 5 µg/L. The system remained active.

In July 2006, EPA collected 13 groundwater samples from active public and private supply wells in and around Cabo Rojo. Chlorinated solvents were detected in groundwater samples from the Ana Maria and the Club de Leones wells but were not detected in the other wells tested, including the Hacienda la Margarita well. Groundwater samples from the Ana Maria well indicated the presence of PCE (1.9 µg/L), TCE (0.62 to 0.63 µg/L), and cis-1,2-dichloroethene (cis-1,2-DCE) (0.66 to 0.67 µg/L). A groundwater sample from the Club de Leones well had 1,1-dichloroethene (1,1-DCE) at 0.96 µg/L (EPA 2010).

From November 29 through December 7, 2006, EPA conducted site reconnaissance activities at 68 facilities within the municipality of Cabo Rojo. Based on the results of the reconnaissance activities, EPA identified 15 facilities as potential sources of the groundwater contamination. In January 2007, EPA conducted source investigations at these facilities. Although chlorinated solvents (i.e., PCE, TCE, cis-1,2-DCE, trans-1,2-dichloroethene [trans-1,2-DCE] and vinyl chloride) were detected at three of the facilities, EPA did not identify the source of groundwater contamination in the public supply wells.

In September 2009, EPA collected additional groundwater samples from the Ana Maria and Club de Leones wells, and from Cabo Rojo 2 (background well) and Cabo Rojo 3 (background well). PCE was detected at 1.1 µg/L in both a sample and sample duplicate collected from the Ana Maria well. A groundwater sample from the Club de Leones well indicated the presence of 1,1-DCE at an estimated concentration. Analytical results for groundwater samples collected from the designated background public supply wells, Cabo Rojo 2 and Cabo Rojo 3, respectively, indicated non-detect values for PCE and 1, 1-DCE.

In July 2011, EPA's Environmental Response Team conducted soil vapor investigations at 13 facilities within the Municipality of Cabo Rojo. Soil vapor results showed detections for DCE, TCE, and PCE at five of the facilities. Three of the facilities with detections were previously identified as potential sources.

In October 2011, the ASTDR evaluated available data, site conditions, and conducted site visits to complete a Public Health Assessment for public comment. ATSDR concluded that the Cabo Rojo Urbano system wells have not exceeded EPA's MCL for the various VOCs detected in the wells and that in the recent past (the past 10 years or so), exposures to VOCs in municipal water were unlikely to harm people's health. ATSDR also concluded that current exposures to VOCs in municipal water from the Cabo Rojo system are unlikely to harm people's health.

1.3 Previous Investigations

Five previous investigations in July 2006, November through December 2006, January 2007, September 2009 and July 2011 were conducted near the site by EPA as part of the Site Discovery Initiative (SDI) to identify the possible sources of groundwater contamination. EPA conducted site reconnaissance activities at 68 facilities; 15 were identified for further investigation. Chlorinated solvents were detected at three of these facilities, as summarized below. In July 2011, EPA conducted a soil vapor investigation at 13 facilities; 5 had detections of chlorinated VOCs including 3 facilities previously identified as possible sources of groundwater contamination. The results of the five identified potential sources are summarized in the following sections (EPA 2010, EPA 2011).

1.3.1 Extasy Q Prints

The Extasy Q Prints (EQP) facility is located in the Centro Comercial Ana Maria strip mall. The facility is located in a mixed commercial/residential area and consists of a portion of a concrete building. A review of regulatory files and databases did not disclose any history of releases or other environmental concerns. Operations at the facility consist of printing T-shirts, towels, and bags with varying designs. The machinery used in the printing process is cleaned with water, petroleum-based cleaners, and rags. Screens used in the printing process are possibly cleaned with liquids that contain VOCs, including PCE. EQP has been in operation at this location since approximately 1986.

On December 1, 2006 and April 4, 2007, EPA conducted site reconnaissance activities at the EQP facility. EPA observed the outdoor screen washing practices, where wash solutions entered a sink and then discharged to the ground. The wash area was multi-colored from washing paints from the screens.

On June 19 and 20, 2007, EPA collected surface soil, subsurface soil, and groundwater samples from borings advanced using direct-push technology (DPT). Samples were analyzed for Target Compound List (TCL) VOCs through the EPA Contract Laboratory Program (CLP). Analytical results from this sampling event indicated detections of VOCs in groundwater samples; there were no detections of VOCs in surface or subsurface soil samples. Groundwater samples contained PCE (8.9 µg/L, 14 µg/L, and 13 µg/L) from two boreholes advanced between the EQP facility and the Ana Maria well.

In June 2011, EPA collected and analyzed soil vapor samples at the EQP facility. Analytical results indicated the presence of PCE (103 to 5,000 parts per billion by volume (ppbv)), TCE (83 to 239 ppbv) and DCE (50 to 1,700 ppbv) at and in the vicinity of the EQP facility.

1.3.2 Cabo Rojo Professional Dry Cleaners

The Cabo Rojo Professional Dry Cleaners (CRPDC) facility consisted of a single-story building and a paved parking lot with a few small areas of exposed soil and vegetation. The site is located in a mixed commercial/residential area in the town of Cabo Rojo. CRPDC was a privately owned and operated family business. The history of the facility before CRPDC began operating in approximately 1987 is unknown. A review of regulatory files and databases did not disclose any history of releases or other environmental concerns. Currently CRPDC is closed.

On November 29, 2006 and April 4, 2007, EPA conducted site reconnaissance activities at the CRPDC facility. Operations at the facility included laundry and dry cleaning. CRPDC used PCE solvent in its dry-cleaning operation and generated PCE-contaminated sludge as a waste material.

EPA conducted a sampling event at and in the vicinity of the CRPDC site on June 20 and 22, 2007. During this event, surface soil, subsurface soil, and groundwater samples were collected from borings advanced using DPT and manually using a stainless-steel auger. Samples were analyzed for TCL VOCs through the EPA CLP. Analytical results from this sampling event indicated the presence of VOCs in surface soil and subsurface soil samples. Surface soil samples contained PCE at 23 micrograms per kilogram (µg/kg) and 29 µg/kg. Subsurface soil had PCE at 73 J µg/kg. PCE was detected at only trace amounts (i.e., below the contract required quantitation limit [CRQL]) in groundwater samples collected at the CRPDC facility.

In June 2011, EPA collected and analyzed soil vapor samples at CRPDC. Analytical results indicated the presence of PCE (4,870 to 64,700 ppbv) and TCE (23 to 113 ppbv) at and in the vicinity of the CRPDC facility.

1.3.3 D'Elegant Fantastic Dry Cleaners

The D'Elegant Fantastic Dry Cleaners (DFDC) facility was located in the southern portion of the Centro Commercial La 100 strip mall, outside the immediate area of the Ana Maria and Club de Leones wells. The strip mall was razed and replaced by a Walgreen store on approximately the same footprint. In addition to the DFDC facility, the strip mall had two restaurants, a hair salon, a bakery, three empty units, and was surrounded by asphalt with parking areas on the northern and eastern side. Historical operations included dry cleaning and spot cleaning of clothing. The dry cleaning and spot cleaning operations used Dowper, commonly referred to as PCE, and Tar Go Dry, a product that contains multiple VOCs, including TCE.

DFDC was in operation at this location from 2005 to approximately 2009. The owner of DFDC indicated that previously another dry cleaner was in operation at this location; however, the duration of operation is unknown.

On November 29, 2006 and April 4, 2007, EPA conducted site reconnaissance activities of the DFDC facility accompanied by DFDC personnel. An empty 55-gallon PCE drum was stored outside the side door of the facility on a concrete pad. All storage and work areas were observed to be in good condition with no apparent spills or discharges. EPA observed that there were no monitoring wells at the site.

On June 15, 2007, EPA conducted a sampling event at the DFDC facility. During this event, EPA personnel collected surface soil, subsurface soil, and groundwater samples which were analyzed for TCL VOCs through the EPA CLP. Analytical results from this sampling event indicated detections of VOCs in soil and groundwater samples. Trans-1,2-DCE (29 μg/kg), cis-1,2-DCE (230 J μg/kg), TCE (130 μg/kg), and PCE (36 μg/kg) were detected in a soil sample collected from just outside the side door of the operations portion of the facility. In addition, groundwater samples collected from the same borehole indicated the presence of cis-1,2-DCE (310 μg/L), TCE (68 μg/L) and PCE (67 μg/L). The EPA HRS Documentation Record (EPA 2010) noted that although both soil and groundwater samples from the DFDC facility indicated the presence of cis-1,2-DCE, TCE and PCE, the facility is not in close proximity to the Ana Maria well (i.e., the DFDC facility is located approximately 4,600 feet southwest of the well).

In June 2011, EPA collected and analyzed soil vapor samples at the former DFDC lot. Analytical results indicated the presence of PCE (420 to 430 ppbv), TCE (220 to 410 ppbv) and DCE (39 to 50,200 ppbv) at and in the vicinity of the of the former DFDC facility.

1.3.4 Serrano II Dry Cleaners

The Serrano II Dry Cleaners (SDC) facility is located along State Road PR-103 on the outskirts of the Pueblo Norte ward, outside the immediate area of the Ana Maria and Club de Leones wells. The SDC is bordered by an empty lot to the east and to the west by Mafalda Daycare. The SDC was first investigated in July 2011 as part of EPA's soil vapor source investigation. Soil vapor samples collected at the SDC resulted in detections for VOCs. Analytical results indicated the presence of PCE (20 to 2,500 ppbv) and TCE (91 to 120 ppbv) at and in the vicinity of the DFDC facility.

1.3.5 PRIDCO East

The Puerto Rico Industrial Development Company (PRIDCO East) complex is located east of State Road PR-100 and west of PR-103, outside the immediate area of the Ana Maria and Club de Leones wells. The complex consists of 10 separate buildings, mostly vacant. Active facilities include manufacturers of military uniforms, a clothing store and a lumber company. PRIDCO East was first investigated in July 2011 as part of EPA's soil vapor source investigation. Soil vapor samples collected at two vacant facilities in the northern portion of the PRIDCO East complex resulted in detections for VOCs. Analytical results indicated the presence of DCE at 23 to 42 ppbv.

1.3.6 United States Geological Survey Study

The United States Geological Survey (USGS) (Rodriguez-Martinez 1996) conducted a study of the hydrogeology and groundwater/surface water relationships in the Cabo Rojo area. This study is summarized in Section 2.1.3 of this work plan. The 1996 study evaluated numerous wells in the local area; CDM Smith will evaluate whether any of these wells would be suitable for use during the RI. If wells are determined to be in suitable locations, the condition of such wells will be evaluated and reported to EPA.

1.4 Current Conditions

On December 9, 2011, CDM Smith visited some of the Cabo Rojo public water supply system wells (Ana Maria, Club de Leones, Cabo Rojo 1, Cabo Rojo 2, and Cabo Rojo 3), the properties investigated by EPA as potential sources, nearby industrial facilities, the McDougal pump station, and other nearby wells. Observations made during the site visit and information provided by EPA are summarized below. Available information on supply wells in the Cabo Rojo area is summarized on Tables 1-1 and 1-2.

- The Ana Maria well is located within a gated facility in a park area. The well is in operation.
- The Club de Leones well is located along State Road PR-103 within a gated facility. Piping and a pump were observed lying outside the pump house. The well is in operation. El Coqui Pump Station, a new waste water/sewage pump station, was observed next to the well.
- The Cabo Rojo 1 well is located close to Rio Viejo along PR-103 within a gated facility. The well is in operation.
- The Cabo Rojo 2 well is located south of Cabo Rojo 1 along PR-103 at the edge of the Bajura lowlands. The well is in operation. An apparent spare pump was observed near the entrance to the pump house.
- The Cabo Rojo 3 well is located close to an automobile junkyard and vehicle repair shops north of the Club de Leones well. The well is in operation.
- The Hacienda Margarita and Remanso wells were not directly observed during the site visit. These two wells are in operation.

- The 2007 Pre-CERCLIS report (Weston 2007) indicated that the McDougal well, located south of the Raul Lugo Storage Yard, was closed because water was no longer needed. EPA provided the information that this well is closed but was converted into a pump station for incoming water from Mayaguez. The pump station appeared to be active during the December 9, 2011 site visit.
- The Terminal de Carros Publicos well located on the south side of Cabo Rojo at the public car terminal is inactive. The pump house gate was unlocked during the site visit in December 2011.
- The Providencia 1 and 2 wells are located within the Cabo Rojo limits/jurisdiction and appeared to be active during the December 2011 site visit.

Most facilities considered for walkover surveys and/or investigations are currently inactive. The CRPDC, SDC, the PRIDCO East vacant buildings, and DFDC facilities are inactive. The building occupied by DFDC was razed and replaced by a new structure. The EQP facility is currently active. Operations involve printing designs on T-shirts, mostly via silk screening.

1.5 Work Plan Content

This Work Plan contains five sections as described below.

- Section 1- Introduction - Presents the site description, site history, previous investigations, and format of the work plan.
- Section 2 – Initial Evaluation - Presents the physical characteristics of the site including regional and site geology, preliminary conceptual site model (CSM), preliminary applicable, relevant, and appropriate requirements (ARARs), data quality objectives (DQOs), and the work plan approach.
- Section 3 – Task Plans - Discusses each task of the RI/FS in accordance with the site SOW, EPA guidance documents, and meetings and discussions with EPA.
- Section 4 – Schedule and Management Approach - Presents the project schedule, project management plan, and quality assurance and document control.
- Section 5 – References - Lists references used to develop the work plan.

For presentation purposes, figures and tables are presented at the end of this Volume 1 Work Plan.

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Section 2
Initial Evaluation

2.1 Review of Existing Data

This section summarizes the current understanding of the physical characteristics of the study area including the topography, drainage and surface water characteristics, regional and site-specific geology and hydrogeology, climate, population, and land use. In addition, this section also includes a preliminary CSM based on the available information; preliminary ARARs, and the overall approach to development of the work plan.

2.1.1 Topography

The Cabo Rojo site is located within a semi-enclosed basin bordered by the Cordillera Sabana Alta to the north, by Cerro Conde Ávila to the west and Monte Grande further south (Figure 1-1). Cordillera Sabana Alta has a maximum elevation of 341 feet above mean sea level (amsl), Conde Avila is approximately 300 feet amsl and Monte Grande is 460 feet amsl. The highest elevation within the site is approximately 2,745 feet east of the Ana Maria well at 115 feet amsl. The lowest elevation is approximately 3,000 feet north of the site in Cienaga De Cuevas at 35 feet amsl.

2.1.2 Drainage and Surface Water

The Guanajibo basin originates in the Central Mountain Range on the west end of the Island of Puerto Rico. It is about 29 kilometers (km) long by 13 km wide and has an area of 345 square kilometers.

The site is located within the Rio Guanajibo alluvial valley. Surface drainage from the site may flow north-northeast into Cienaga de Cuevas swamp and eventually to the Rio Guanajibo, or may recharge the bedrock aquifer influenced by a cone of depression caused by the public supply wells. The Rio Guanajibo flows in a general north-northwest direction approximately two miles from the site. Surface water from Cabo Rojo Pueblo and other nearby highland areas discharges into creeks Quebrada Mendoza, Quebrada Pileta, Quebrada La Piedra that discharge into Rio Viejo and Cienaga de Cuevas, recharging the aquifer or eventually reaching the Rio Guanajibo (Figure 2-1).

2.1.3 Geological and Hydrogeological Characteristics

The geological and hydrogeological characteristics of the Cabo Rojo site are described in the following sections. Descriptions of geological and hydrogeological characteristics were obtained mainly from the USGS Geologic Map of the Puerto Real Quadrangle (Volkman

1984), and a water investigation report on the Hydrogeology and Ground-Water/Surface-Water Relations in the Bajura Area of the Municipio de Cabo Rojo, Southwestern Puerto Rico (Rodriguez-Martinez 1996).

2.1.3.1 Regional and Site-Specific Geology

The investigation area lies within the southwestern tectonic block of Puerto Rico, which is bounded to the south mostly by northeast-southwest-trending high angle fault zones (Volkman 1984). Two north-northwest and northwest faults are present northwest of the site. A USGS publication (Rodriguez-Martinez 1996) suggests that the Cienaga De Cuevas swamp area may be a graben resulting from localized block faulting. The geology of the area consists of upper Cretaceous volcanic deposits belonging to the Sabana Grande Formation (Ks), Lajas Formation (Kl) and Yauco Formation (Ky and Kyc), bedrock from the Cotui Limestone (Kc), and Quaternary alluvium (Qa) and swamp deposits (Qs) (Figure 2-2).

Approximately 2,000 feet south of the Club de Leones well, a northeast-west trending fault separates the Sabana Grande Formation from the Lajas Formation and Cotui Limestone.

According to the Geologic Map of the Puerto Real Quadrangle (Volkman 1984) the units presumed to lie in the subsurface at the study area are summarized below.

- Sabana Grande Formation (Ks - upper Cretaceous age) - Predominantly andesitic tuff, tuff-breccia, and conglomerate with minor basaltic lava and breccias.
- Alluvium (Qa – Quaternary age) – Predominantly consisting of clay, silt, sand and gravel.

Nearby geologic units that may be relevant to this investigation and perhaps present in the surface-subsurface (Rodriguez-Martinez 1996) are summarized below.

- Swamp deposits (Qs – Quaternary age) – Predominantly sand, silt, clay and organic material deposited in areas of poor drainage.
- Cotui Limestone (Kc - upper Cretaceous age) – Medium-gray to brownish-gray, thick bedded to massive, fossiliferous limestone. The limestone may be cavernous and show strong solution effects.
- Lajas Formation (Kl - upper Cretaceous age) – Predominantly consisting of basalt flows and minor tuffs.
- Yauco Formation (Kyc - upper Cretaceous age) – Predominantly consisting of the conglomerate phase of the Ky; clasts are composed of volcanic rock, siltstone and claystone.

Due to the proximity of the fault zones to the ground surface and the public supply wells, it is presumed that the deposits in the site's subsurface may be fractured and may include intrusions from nearby geologic formations.

2.1.3.2 Regional Hydrogeology

The hydrogeologic terrain in the study area consists mainly of alluvial deposits underlain by limestone rock. The site is located within the east-southeast trending Rio Guanajibo valley, one of the largest of a series of alluvial valleys that occur within the West Coast (groundwater) Province (EPA 2010). Drainage from the highlands including some areas of Cabo Rojo Pueblo is via the Quebrada Mendoza, Quebrada Pileta, and Quebrada La Priedra into Rio Viejo and Ciénaga de Cuevas swamp area (Rodriguez-Martinez 1996). These water bodies eventually drain into the Rio Guanajibo north of the Cabo Rojo area (Figure 2-1). According to a USGS publication, segments of the Río Viejo and other streams that drain to the Ciénaga de Cuevas swamp area and the swamp itself are sources of recharge to the aquifer. This condition exists as a result of the pumping of public water-supply wells (i.e., Cabo Rojo 1, Cabo Rojo 2, Cabo Rojo 3, and Club de Leones) located in the vicinity of the low-lying Ciénaga de Cuevas/Bajura area. The hydrologic and hydraulic data also indicated that prior to groundwater development of the aquifer beneath the Ciénaga, the swamp was more likely a discharge rather than a recharge feature of the aquifer. Estimated values for specific capacity and transmissivity in the Bajura area are in the range from 2 to 18 gallons per minute per foot (gal/min/ft) and 270 to 5,600 square feet per day (ft^2/d), respectively (Rodriguez-Martinez 1996).

2.1.3.3 Site-Specific Hydrogeology

The site is located in the Guanajibo alluvial valley which consists of bedded sand and gravel alluvium underlain by limestone (USGS 2002). The primary source of groundwater at the site is the water-table aquifer, a heterogeneous aquifer composed mainly of limestone and secondary amounts of gravels, sands, and clayey sands (USGS 2002). Geologic cross-sections for the Cabo Rojo region published by the USGS confirm that there is no continuous confining layer separating the alluvial valley aquifer and the bedrock aquifer within two miles of the groundwater plume (EPA 2010). Groundwater flow is likely influenced by pumping at the public water-supply wells and the cone of depression created by the pumping. According to information published by the USGS (Rodriguez-Martinez 1996), the Club de Leones well is 150 feet deep with an open or screened section from 90 to 150 feet and the Ana María well is 200 feet deep with an open or screened section from 40 to 200 feet. Well construction information for Cabo Rojo 1 is unknown. The HRS package (EPA 2010) assumed that Cabo Rojo 2 and Cabo Rojo 3are screened from 33 to 143 feet bgs. All wells are assumed to extend into the limestone bedrock aquifer.

The interconnected water supply system consisting of Hacienda la Margarita, Cabo Rojo 1, Cabo Rojo 2, Cabo Rojo 3, and Club de Leones serves an estimated population of 45,055 people. The Ana Maria well acts as an independent system which serves approximately 1,856 people. Wellhead Protection Areas are delineated for the contaminated public supply wells, so the contamination lies within a designated Wellhead Protection Area.

2.1.4 Climate

The climate for the Cabo Rojo area is characteristic of southwest Puerto Rico and is classified as tropical and humid. The climate is moderated by the nearly constant trade winds that originate in the northeast. The average annual average temperature for the Cabo Rojo area is approximately 76° Fahrenheit (F). Precipitation data from 1971 to 2000 show an annual precipitation of 55 to 60 inches as reported on the National Oceanographic and Atmospheric Administration (NOAA) Southeast Regional Climate Center website: http://www.sercc.com/climateinfo/historical/historical_pr.html CDM Smith will obtain both historical and current climate data, including, but not limited to, temperature, precipitation, wind speed, and wind direction, from local meteorological stations. Climate data will be collected during the course of the field investigation and will be incorporated in the RI report.

2.1.5 Population, Land Use and Hazardous Waste Sites

The water supply system affected by VOC contamination serves only the Cabo Rojo population. The Cabo Rojo municipality is 72 square miles in size with a population of 50,917; the Bajura ward has a population of 2,423 (U.S. Census 2010). The primary land uses in the vicinity of the site are agricultural, residential, and commercial development.

In addition to the Cabo Rojo site, the following sites were listed in the CERCLIS database as of August 20, 2012.

1. PRN000206055 – Abandoned Mechanic, Road 100, Km 5.1, Non-NPL site
2. PRN000206062 – Piezas Javy, Road 103, Km 7.1, Non-NPL site
3. PRN000013433 – Cabo Rojo Professional Dry Cleaners, 50 Calle Carbonell, Non-NPL site
4. PRN000206066 – Centro de Acopio (obras publicas), Calle Periferal Norte Final, Non-NPL site
5. PRN000206063 – Centro de Transmiciones, 1 Calle Jose de Diego, Non-NPL site
6. PRN008009185 – D'Elegant Fantastic Dry Cleaners, Road 308/Centro Commercial LA100, Non-NPL site
7. PRN981567183 – Eaton Cutler-Hammer Electrical Co, Former, Road 103, Km 7.4, Non-NPL site
8. PRN000206061 – Extasy Q Prints, Centro Comercial Ana Maria, Non-NPL
9. PRN000206068 – L & R Auto and Truck Repair, Road 103, Km 4.0, Non-NPL
10. PRN000204378 – Puerto Rico Containers, St. Road 2, Km 15.2, Corujo Industrial Park, non-NPL

2.1.6 Conceptual Site Model

A preliminary CSM was developed for the site using existing information derived from previous investigations, preliminary understanding of site characteristics, and relevant background information provided by EPA. The preliminary CSM integrates the existing information into a model of potential contaminant distribution and migration and establishes a framework for evaluating data, identifying data gaps, and developing the technical approach for the field investigation. The preliminary CSM will be updated and refined as additional information on physical site characteristics, contaminant sources, migration pathways, and receptors is collected during the course of the RI. Figure 2-3 illustrates the preliminary CSM.

2.1.6.1 Sources of Contamination

The site was listed on the NPL as a contaminated groundwater plume with no identified source(s) of contamination. Currently, the site is defined by VOC contamination in groundwater in the Ana Maria and Club de Leones wells at concentrations below the MCLs.

Previous investigations resulted in the identification of five potential sources of groundwater contamination: EQP, CRPDC, DFDC, SDC, and PRIDCO East. PCE was found in groundwater and soil vapor samples collected at EQP; TCE and DCE were also detected in EQP soil vapor samples. At the former CRPDC, PCE was detected in soil vapor, surface and subsurface soils, and in trace amounts in groundwater. PCE, TCE, and cis-1,2-DCE were detected in both soil and groundwater samples at the former DFDC, and trans-1,2-DCE was detected in soil samples. Soil vapor samples collected at the former SDC contained DCE. At PRIDCO East, DCE was detected in soil vapor samples.

This aspect of the CSM will be refined throughout the RI as additional information on contaminant sources becomes available.

2.1.6.2 Expected Transport and Fate of Site Contaminants

Groundwater

Currently, there is little information about how contaminants at the site are transported within the unsaturated zone and within groundwater. Liquid chlorinated solvents such as PCE and TCE, when discharged to the ground surface, would migrate downward through the unsaturated zone in a relatively linear pattern, with minimal dispersion from the discharge location. This would generally be the pattern when sand and gravel predominate beneath the source areas. In parts of the alluvium where clays are present beneath potential source areas, migration of liquid solvents could be complicated. Discharged solvents would migrate downward to the top of clay lenses, pool, begin to migrate across the surface of the clay until a gap in the clay is encountered and then migrate downward through coarser sediments to the groundwater table. The unsaturated zone may vary in thickness throughout the Cabo Rojo area.

Once the liquid solvents encounter the water table, some of the solvent would dissolve into the groundwater and begin to move in the direction of groundwater flow within the cone of depression formed by the well field. Chlorinated solvents in a dissolved phase move with the groundwater flow, but generally at a slower rate than groundwater. If the solvent reaching the water table is of sufficient quantity, some of the solvent may remain in an undissolved state as dense non-aqueous phase liquid (DNAPL). Since PCE and TCE are denser than water, the solvent would continue to move downward through sand and gravel sediments in the alluvium or fractures or solution features in the limestone aquifer. DNAPL would sink until it encounters a lower permeability zone, such as a clay layer or the volcanic bedrock surface, which would slow or stop the downward migration. DNAPL could pool or accumulate on these low permeability zones, remain stationary or spread laterally under the influence of gravity. As DNAPL passes through the aquifer material, some may stay within the pore spaces or small fractures due to capillary pressure. This DNAPL is called "residual DNAPL" and can remain as a continuing source of soil vapor and groundwater contamination. Residual DNAPL within the unsaturated zone can be dissolved and migrate to the saturated zone via infiltrating precipitation. The full extent of contamination in the aquifer and whether DNAPL is present are currently unknown.

Under suitable anaerobic conditions, the solvents can be biodegraded by a microbial process called reductive dechlorination. The parent compound PCE will degrade to TCE, DCE, and vinyl chloride. DCE can occur as three isomers: 1,1-DCE, cis-1,2-DCE, and trans-1,2-DCE. The cis-1,2-DCE isomer is by far the most prevalent product of the degradation of PCE and TCE. It is currently unknown whether the aquifer is anaerobic or aerobic.

Air

PCE, DCE, and TCE are VOCs. As such, VOCs spilled or discharge to the ground surface volatilize to the atmosphere and in the unsaturated zone, to the pore spaces between soil particles. Volatile chemicals dissolved in groundwater also volatilize into the overlying unsaturated zone as a plume moves downgradient with the groundwater flow. Vapors move through the unsaturated zone pore spaces, often seeking preferential flow pathways such as sandier zones with more porosity and permeability, including gravel commonly placed beneath concrete basements or pipelines that may be backfilled with sandy material. As vapors move through the unsaturated zone, they can enter structures, such as homes, affecting air quality. Vapor movement may also be affected by differential pressure gradients, either natural (e.g., caused by weather changes) or man-made (e.g., pressure differences inside and outside structures).

Surface Water/Sediment

The groundwater flow direction is expected to be strongly influenced by pumping at the well field in the vicinity of the Club de Leones well. According to the USGS (Rodriguez-Martinez 1996), surface water recharges the aquifer. However, at times when wells are inactive or during exceptional precipitation events, the recharge may overwhelm the effect of the pumping and groundwater may discharge directly into the wetlands. The hydrology of the groundwater system will be evaluated during the RI and the surface water/groundwater interaction in the vicinity of the wetlands will be evaluated, if appropriate. Within the populated areas, creeks are concrete lined. Therefore, little potential exists for contamination from the groundwater to affect the quality of surface water and/or sediments in the creeks in the populated areas of the site.

2.2 Preliminary Identification of Applicable or Relevant and Appropriate Requirements

This section provides a preliminary determination of the regulations that are ARARs to remediation of the groundwater, soil, surface water and sediment at the Cabo Rojo site. Both federal and Commonwealth environmental and public health requirements are considered. In addition, this section identifies federal and Commonwealth criteria, advisories, and guidance documents that could be used to evaluate remedial alternatives. Such criteria, advisories, and guidance documents are referred to collectively as "To Be Considered" (TBCs). Only those ARARs and TBCs that are considered relevant to the site are presented.

ARARs and TBCs are classified as chemical-specific, location-specific, or action-specific. Descriptions of these classifications are provided below.

- Chemical-Specific ARARs or TBCs are usually health or risk-based numerical values, or methodologies which when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.
- Location-Specific ARARs or TBCs generally are restrictions imposed when remedial activities are performed in an environmentally sensitive area or special location. Some examples of special locations include flood plains, wetlands, historic places, and sensitive ecosystems or habitats.
- Action-Specific ARARs or TBCs are restrictions placed on particular treatment or disposal technologies. Examples of action-specific ARARs are effluent discharge limits and hazardous waste manifest requirements.

The identification of ARARs and TBCs occurs at various points during the RI/FS and throughout the remedial process. ARARs and TBCs are used to determine the extent of cleanup, to scope and formulate remedial action alternatives, and to govern the implementation of the selected alternative.

Table 2-1 provides a preliminary list of ARARs and TBCs. This preliminary list is based on current site knowledge and will be reviewed and updated during the RI/FS process as more site-specific information becomes available, and as new or revised ARARs and TBCs are established.

2.3 Data Quality Objectives

DQOs are qualitative and quantitative statements that specify the quality of data required to support decisions regarding remedial response activities. DQOs are based on the end uses of the data collected. The data quality and the level of analytical documentation necessary for a given set of samples will vary, depending on the intended use of the data. DQOs ensure that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended application.

Sampling data will be required to evaluate whether or not remedial alternatives can meet remedial response objectives. The intended uses of these data dictate data confidence levels. The document *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA 2006a) was used to determine the appropriate analytical levels needed to obtain the required confidence levels. The three data levels are: screening data with definitive-level data confirmation, definitive-level data, and field measurements meeting field measurement-specific data quality indicator (DQI) requirements. DQIs such as precision, accuracy, representativeness, comparability, completeness, and sensitivity will be defined in the site-specific QAPP (Table 2-2).

2.4 Work Plan Approach

The overall objectives for the RI/FS for the site include determination of the nature and extent of groundwater contamination, identification and evaluation of contamination in potential sources areas (PSAs), evaluation of surface water and sediment contamination, completion of risk assessments, and evaluation remedial alternatives for affected media. The primary objectives to be achieved during this RI/FS are summarized below.

- Define the nature and extent of groundwater and soil contamination at the Cabo Rojo site. The field investigation program to achieve this goal is described in Section 3.3.
- Update the preliminary CSM based on an understanding of the hydrogeologic framework for the site, interactions between surface water and groundwater, and the location of contaminant sources. The current CSM is summarized in Section 2.1.6.
- Identify and quantify potential human health and ecological risks, if any, posed by exposure to contaminated groundwater, surface and subsurface soil (if a source is identified), or contaminated surface water and sediment. The risk assessment approach to achieve this goal is described in Section 3.1.13. EPA will complete the HHRA and SLERA reports.
- Develop remedial alternatives for primary sources (if identified) and affected media and conduct a detailed analysis of appropriate remedial alternatives for the sources, and affected media. The FS approach to achieve these goals is detailed in Sections 3.10 through 3.12.

2.4.1 Development of the Technical Approach

CDM Smith reviewed all available information on the site prior to formulating the technical approach presented in this work plan. Section 5 provides a list of the documents reviewed and referenced during development of the work plan.

On January 9, 2012, CDM Smith held a technical scoping meeting with EPA in the San Juan and New York offices. At the meeting, CDM Smith summarized the background information; presented the technical approach for the RI/FS field investigation; and solicited input from the EPA Project Officer (PO), Remedial Project Manager (RPM), and EPA technical specialists. The technical approach to the field investigation (Section 3.3) was revised based on input from EPA and discussions at the technical scoping meeting.

Review of background documents indicates that there is little information available concerning the extent of contamination at the site, physical characteristics including the site geology and hydrogeology, and potential contaminant sources. Because no source of contamination has been identified, the RI will also investigate potential contaminant sources in the vicinity of the identified groundwater contamination.

After the technical meeting in January, CDM Smith reviewed additional technical information for the area of interest. The additional information is summarized in Section 1 of this work plan. The work plan includes field investigations of known areas (e.g., the five PSAs identified previously by EPA) and several other PSAs (see Sections 3.3.1.1 and 3.3.4).

2.4.2 Field Investigation Approach

The goal of the field investigation is to collect all the data required to define the nature and extent of contamination, perform a quantitative HHRA, a SLERA and an FS, at a site with unknown sources and limited known geologic and hydrogeologic data, in a single, cost-effective, mobilization. To achieve this objective, a dynamic approach using built-in decision points, appropriate use of screening-level data, continuous evaluation of data and refinement of the CSM has been developed. The approach will allow the identification of data gaps while the field staff is still in the field to collect additional data.

Two significant data gaps in the CSM include the limited understanding of the hydrogeological framework and the identities of source areas. The field investigation will proceed such that these data gaps are filled first so that the collected data can be used to direct the course of the remaining investigation activities. To enhance the understanding of the hydrogeological framework, continuous water level monitoring will be performed for approximately two months, including two week prior to beginning evaluation of existing wells (see Section 3.3.3.1.1). This early monitoring will assist with determination of the current effect of wellfield pumping on the overall hydrogeology.

Five PSAs were identified during previous investigations by EPA. A reconnaissance site visit will be conducted to identify other PSAs through visual observation and interviews with local residents. Information obtained during the reconnaissance will be discussed with EPA prior to implementing PSA sampling and other investigation activities. A dynamic PSA soil and groundwater investigation will be conducted at the five identified PSAs and any additional PSAs identified during the reconnaissance and approved by EPA.

- At any newly-identified PSA, CDM Smith will perform a soil gas survey, analyzing gas samples in the field with a portable field gas chromatograph (GC). If PCE, TCE, or DCE are detected, soil screening will be recommended to EPA. CDM Smith will also identify surface water drainage features (e.g., catch basins) that may be present at each PSA to help clarify surface water/runoff in the CSM and to determine whether samples should be collected.

- Soil and groundwater screening samples will be collected using direct push technology (DPT) at locations based on the soil gas sampling results. The soil and groundwater samples will be analyzed in the field using a field GC to provide real-time screening level VOC data.

- If PCE, TCE, and/or DCE are detected in the screening level samples, DPT will be used to collect soil for TCL VOC analysis at a CLP laboratory. The purpose of this soil sampling is to delineate the horizontal and vertical extent of soil contamination during the PSA investigations.

- If PCE, TCE, and/or DCE are detected in the screening level samples collected at a PSA, surface water and sediment samples will be collected from catch basins or other surface water features identified at that PSA. The surface water and sediment samples will be submitted to a CLP laboratory for TCL VOC analysis.

The hydrogeologic investigations also will be dynamic, as described below.

- Three existing supply wells will be geophysically logged to identify water-bearing fracture zones. The data will be reviewed by a CDM Smith Hydrogeologist in the field and the Hydrogeologist will provide recommendations about which water-bearing zones or fractures to sample to the EPA Hydrogeologist.

- The EPA Hydrogeologist will select the zones for sampling in real time allowing the sampling to immediately follow the logging. A wire-line sampler will be used to collect groundwater immediately above and below each water bearing zone or fracture and will be analyzed for VOCs by an EPA CLP laboratory, Division of Environmental Science and Assessment (DESA), or subcontractor laboratory with 48-hour turn-around.

- Data from the supply wells as well as from the groundwater and soil screening level data from PSAs will be evaluated to recommend to EPA locations and construction of overburden wells at the PSAs. The wells will be installed upon EPA approval of the locations and construction details.

- Preliminary VOC results from public supply wells and soil and groundwater samples from PSAs will be used to recommend to EPA locations between the PSAs and the production wells for installation of multiport monitoring wells. The wells will be constructed upon approval from EPA.

- Additional, optional activities will be added to the hydrogeologic investigation as needed to further develop the understanding of the CSM. The following optional activities would not be initiated until after consultation with and approval from EPA.

    - Matrix diffusion study

    - Cross-borehole testing

    - Wetland sampling and surface water/groundwater interaction study

Other sampling/field activities will also be implemented or considered for the field investigation. These activities include or potentially include:

- Ecological Characterization: CDM Smith will perform an ecological characterization at the site which will include a qualitative assessment of general site habitats. The purpose of the field effort is to identify site habitats both within and in the vicinity of the site that may potentially be affected by site contaminants. If the enhanced understanding of the hydrogeological framework indicates that contaminated groundwater discharges to the large wetland area near the site, CDM Smith will consult with EPA regarding additional sampling and characterization of these wetland areas.

Details of the procedures for implementing all aspects of the RI investigation are included in Section 3.

2.4.3 Laboratory Analyses

The CDM Smith field team will collect environmental samples in accordance with EPA-approved rationale, procedures, and protocols provided in the project-specific QAPP. Routine Analytical Services

(RAS) samples will be analyzed in compliance with the Field and Analytical Services Teaming Advisory Committee (FASTAC) policy. CDM Smith will pursue the use of the CLP or DESA prior to engaging in a laboratory subcontract and alternatives to standard CLP analysis will be sought with the EPA Regional Sample Control Coordinator (RSCC), prior to any sample collection activities and analyses via a subcontracted laboratory. Under the "flexibility clause" of the CLP, modifications can be made to CLP SOWs, enabling achievement of method detection limits (MDLs) that may meet the stated criteria.

CDM Smith will implement the EPA Region 2 Policy described below.

Tier 1: DESA Laboratory (including Environmental Services Assistance Team (ESAT) support)

Tier 2: National Analytical Services Contracts (including EPA CLP)

Tier 3: Region specific analytical services contracts

Tier 4: Obtaining analytical services using subcontractors via field contracts (using RAC subcontractors via Master Service Agreements)

All fixed laboratory analytical needs will be submitted to the EPA RSCC regardless of the ability of the EPA or CLP laboratory to perform the required analyses. CDM Smith will utilize subcontract laboratory services only in the event that the first three tiers are not available.

The RAS analytical results will be validated by EPA or DESA. CDM Smith will validate all non-RAS data, except data that are analyzed and validated by DESA. CDM Smith will then tabulate all data collected during the field investigation activities and use it to support the RI/FS.

2.4.4 Sustainable Remediation/Green Remediation

Green Remediation is the practice of considering all environmental effects of the implementation of a remedy and incorporating options to maximize the net environmental benefit of cleanup actions. In accordance with EPA's strategic plan for compliance and environmental stewardship, the Agency strives for cleanup programs that use natural resources and energy efficiently, reduce negative impacts on the environment, minimize or eliminate pollution at its source, and reduce waste to the maximum extent possible.

The EPA Region 2 Superfund program supports the adoption of "green site assessment and remediation," which is defined as the practice of considering all environmental impacts of studies, selecting and implementing a given remedy, and incorporating strategies to maximize the net environmental benefit of cleanup actions (see http://www.clu-in.org/greenremediation).

On March 17, 2009, Region 2 established a "Clean & Green" policy to enhance the environmental benefits of Superfund cleanups by promoting technologies and practices that are sustainable. This policy applies to all Superfund cleanup projects, and is available at http://www.epa.gov/region02/superfund/green_remediation/_policy.html. To the extent possible, CDM Smith will purchase 100 percent of the electricity for this project from renewable sources and use clean diesel fuels and technologies during the performance of this work assignment. Under EPA's policy, certain green remediation technologies will serve as touchstones for Region 2 response actions. The Region 2 "touchstone technologies" include the following examples.

- Use of 100% of electricity from renewable sources http://www.epa.gov/osw/partnerships/c2p2/index.htm
- Concrete made with Coal Combustion Products replacing a portion of traditional cement
- Clean diesel fuels and technologies http://www.epa.gov/lmop/overview.htm - methane
- Methane capture at landfill sites http://apps3.eere.energy.gov/greenpower/buying/buying_power.shtml and http://www.epa.gov/oms/retrofit/nonroad-list.htm

To the extent practicable, CDM Smith will explore and implement green remediation strategies and applications in the performance of the requirements of this work assignment to maximize sustainability, reduce energy and water usage, promote carbon neutrality, promote industrial materials reuse and recycling, and protect and preserve land resources. CDM Smith will maintain records of "green-related" activities, and report this information to EPA in its monthly progress reports or as requested by the Project Officer.

The following guidance documents provide additional information regarding the implementation of "Green Remediation" practices.

- Green Remediation Practices
- Federal Acquisition Regulation, Part 23, "Environment, Energy and Water Efficiency, Renewable Energy Technologies, Occupational Safety, and Drug-Free Workplace:" Federal Acquisition Regulation (FAR) Subparts 23.2, 23.4, 23.7, and 23.8 (see http://www.arnet.gov/far/05-23-1/html/FARTOCP23.html)
- Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management" (January 2007) (http://www.epa.gov/oaintrnt/practices/eo13423.htm

2.4.5 Project Data Management and Electronic Data Deliverable Requirements

The goals of project data management are to store and manage the data generated during the project so that it is ready and available for analysis and reporting, and to prepare the project electronic data deliverable (EDD) for submittal to EPA. Examples of the data to be managed during this project include log books, maps, field data sheets, location data (survey and global positioning system [GPS]), lithologic and well construction data, water level data, borehole geophysical data, field results, and sample analytical results. Data on paper will be stored and managed using CDM Smith's project filing system. Data in electronic format will be stored and managed using Environmental Quality Information Systems (EQuIS) environmental database software from EarthSoft (version 5.5 or current version). The EQuIS database provides a standard format for data storage and reporting. It will also support the analysis and presentation of data using gINT, Microsoft Excel, ArcMAP Geographic

Information System (GIS) software, AutoCAD, Surfer, and other applications as needed. The data stored in EQuIS will ultimately be used to generate the required EPA Region 2 EDD.

The key data management roles on the project include the data provider, the site manager, the data quality task leader (DQTL), project staff, the EQuIS database administrator, and the analytical services coordinator (ASC). The site manager and DQTL work together to ensure that data management is conducted in a timely and efficient manner and that proper quality assurance/quality control (QA/QC) procedures are followed. Data will be uploaded to the database from Excel EDD files prepared by project staff to ensure the data are complete and accurate. The EQuIS database administrator is responsible for verifying that excel EDDs comply with EPA Region 2 requirements, loading the EDDs into EQuIS and creating reports. EDDs which do not comply with EPA Region 2 requirements will be returned to the DQTL to be revised. The ASC logs analytical EDDs received from laboratories into the EDD tracking system; works with laboratories; assists in arranging data validation; and trouble shoots problem analytical EDDs.

Good communication between project team members during the project is a key to successful data management. To facilitate communications, meetings will be held during project planning and at key points when data are transferred from one task to another on the project.

At the conclusion of the project, CDM Smith will provide EPA with a project EDD which includes field sampling and laboratory analytical results, geologic data, and well location data in accordance with Region 2's policies, guidelines, and formats.

CDM Smith will follow Region 2's "Comprehensive Electronic Data Deliverable Specification Manual 2" (EPA 2011)) for the systematic implementation of EDD, and data preparation and identification of data fields required for data submissions. Other Region 2 EDD guidance and requirements documents that CDM Smith will follow include the "Electronic Data Deliverables Valid Values Reference Manual" and tables (EPA 2011a), the "Basic Manual for Historic Electronic Data," (EPA 2011b) the "Standalone EQuIS Data Processor User Guide," and EDD templates (EPA 2011c).

2.4.6 Record-Keeping Requirements

CDM Smith will maintain all technical and financial records for this work assignment in accordance with the requirements of the SOW and the technical direction of the EPA RPM. These technical and financial records will be in sufficient detail to support decisions made during this RI/FS. At the completion of the work assignment, CDM Smith will submit three bound copies of the official record of the work and one copy of the major deliverables in electronic format to the EPA RPM, with one copy to the EPA Records Manager.

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Section 3
Task Plans

The tasks identified in this section correspond to EPA's SOW for the site, dated August 25, 2011. The tasks for the RI/FS presented below correspond to the applicable tasks presented in the Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA 1988). In addition, EPA's SOW includes a task for project close-out. The task presentation order and numbering sequence correspond to the work breakdown structure provided in EPA's SOW.

3.1 Task 1 RI/FS Work Planning

The project planning task generally involves several subtasks that must be performed in order to develop the plans and the corresponding schedule necessary to execute the RI/FS. These subtasks include project administration, conducting a site visit, performing a review and detailed analysis of existing data, attending technical meetings with EPA and other support agencies, preparing this RI/FS work plan, preparing the QAPP and HSP, procuring and managing subcontractors, and preparing the Pathways Analysis Report (PAR).

3.1.1 Project Administration

The project administration activity involves regular duties performed by the CDM Smith Site Manager (SM) and the program support personnel throughout the duration of this work assignment. CDM Smith will provide the following project administration support in the performance of this work assignment.

The SM will:

- Prepare the technical monthly report
- Review weekly financial reports
- Review and update the project schedule
- Attend quarterly internal RAC 2 meetings
- Communicate regularly with the EPA Remedial Project Manager (RPM)
- Prepare staffing plans

The program support personnel will:

- Review the work assignment technical and financial status
- Review the monthly progress report
- Provide technical resource management
- Review the work assignment budget
- Respond to questions from the EPA Project Officer (PO) and Contracting Officer (CO)
- Prepare and submit invoices

3.1.2 Attend Scoping Meeting

On November 7, 2011, CDM Smith's Program Manager, SM, Finance and Administration Manager (FAM), and Contract Specialist (CS), attended an initial scoping meeting with the EPA RPM, PO, CO and Pre-Remedial Section Chief in New York and by teleconference to outline and discuss the project scope.

A technical scoping meeting was held on January 9, 2012 in person and via teleconference with personnel at the EPA Region 2 office in New York, New York and CDM Smith's office in San Juan, Puerto Rico. CDM Smith attendees included the Program Manager, SM, Remedial Investigation Task Manager (RITM), Feasibility Study Task Leader (FSTL), Human Health and Ecological Risk Assessors, and Project Geologist (PG). EPA attendees included the PO, RPM, Quality Assurance (QA) Officer, Technical Group Leader, Ecological Risk Assessor, and Hydrogeologist. CDM Smith gave a slide presentation including a brief summary of the site history, site definition, ongoing activities, and a proposed technical approach. The group discussed the scope of work, additional potentially available documentation, and ongoing site activities.

3.1.3 Conduct Site Visit

The CDM Smith SM conducted a site visit with the CDM Smith PG on December 9, 2011. The site visit included visual observation of site conditions, current uses of surrounding and potentially involved properties, inspection of surface water features and bedrock outcrops, and evaluation of potential logistical and safety issues. CDM Smith will also conduct a two day site visit to inspect existing PRASA boreholes and PSAs identified following the technical scoping meeting.

3.1.4 Develop Draft Work Plan and Associated Cost Estimate

CDM Smith prepared draft RI/FS work plans in accordance with the contract terms and conditions. CDM Smith used existing site data and information, information from EPA guidance documents (as appropriate) and technical direction provided by the EPA RPM as the basis for preparing the final work plans.

The draft work plan included a comprehensive description of project tasks, the procedures to accomplish them, project documentation, and a project schedule. CDM Smith uses internal quality assurance/quality control (QA/QC) systems and procedures to insure that the work plan and other deliverables are of professional quality requiring only minor revisions (to the extent that the scope is defined and is not modified). Specifically, the draft work plan included the following information.

- Identification of RI project elements including planning and activity reporting documentation, field sampling, and analysis activities. A detailed work breakdown structure of the RI corresponded to the work breakdown structure provided in the EPA SOW (dated August 25, 2011) and discussions with EPA.
- CDM Smith's technical approach for each task to be performed, including a detailed description of each task, the assumptions used, any information to be produced during and at the conclusion of each task, and a description of the work products to be submitted to EPA. Issues relating to management responsibilities, site access, site security, contingency procedures and storage and disposal of investigation derived wastes (IDW) were also addressed. Information was presented in a sequence consistent with the SOW.
- A schedule with dates for completion of each required activity, critical path milestones and submission of each deliverable required by the SOW and the anticipated review time for EPA.
- A list of key contractor personnel supporting the project (Section 4) and the subcontractor services required for the work assignment.

CDM Smith prepared and submitted a draft work plan budget (as Volume 2 of the RI/FS work plan) that followed the work breakdown structure in the SOW. The draft work plan budget contained a detailed cost breakdown, by subtask, of the direct labor costs, subcontractor costs, other direct costs, projected base fee and award fee, and any other specific cost elements required for performance of each of the subtasks included in the SOW. Other direct costs were broken down into individual cost categories as required for the work assignment, based on the specific cost categories negotiated under CDM Smith's contract. A detailed rationale describing the assumptions for estimating the professional level of effort (PLOE), professional and technical levels and skills mix, subcontract amounts, and other direct costs were provided for each subtask in the SOW.

3.1.5 Negotiate and Revise Draft Work Plan/Budget

CDM Smith personnel attended a work plan negotiation meeting. EPA and CDM Smith personnel discussed and agreed upon the final technical approach and costs required to accomplish the tasks detailed in the work plan. CDM Smith is submitting a negotiated work plan and budget incorporating the agreements made in the negotiation meeting. The negotiated work plan budget includes a summary of the negotiations. CDM Smith will submit the negotiated work plan and budget in both hard copy and electronic formats.

3.1.6 Evaluate Existing Data and Documents

As part of the preparation of the work plan, CDM Smith reviewed data collected during previous investigations at the site. Analytical data and other information from these background documents were incorporated, where applicable, into this planning document. Existing data are summarized in Section 2.

Additional information requested from local agencies for wells and facilities that are in the Cabo Rojo area has been reviewed and summarized in Section 1 of this document.

3.1.7 Quality Assurance Project Plan

CDM Smith will prepare a QAPP in accordance with the "EPA Requirements for Quality Assurance Project Plan (EPA QA/R-5" (EPA 2001), the "Uniform Federal Policy for Quality Assurance Project Plans" (EPA 2005), EPA Guidance for QAPPs (EPA 2002a) and other current regional procedures, and CDM Smith's RAC 2 Quality Management Plan (CDM Smith 2012a and b). The Uniform Federal Policy (UFP) QAPP will be submitted as a separate deliverable. The QAPP describes the project objectives and organization, functional activities, and QA/QC protocols that will be used to achieve the required DQOs. The DQOs will, at a minimum, reflect the use of analytical methods to identify and address contamination consistent with the levels for remedial action objectives identified in the National Contingency Plan (NCP).

The QAPP describes the number, type, and location of samples and type of analyses to be performed. The QAPP includes sampling objectives; sample locations and frequency; sampling equipment and procedures; personnel and equipment decontamination procedures; sample handling and analysis; and a breakdown of samples to be analyzed through the CLP and through other sources, as well as the justification for those decisions. The QAPP is written so that a field sampling team unfamiliar with the site would be able to collect the samples and field measurements. Technical Standard Operating Procedures (TSOPs) are included in the QAPP; worksheets include clarifications and/or modifications to the TSOPs to meet regional and project requirements and the site-specific HSP.

The QAPP also addresses site management, including site control and site operations. The site control section describes how approval to enter the areas of investigation will be obtained, along with the site security control measures, and the field office/command post for the field investigation. The logistics of all field investigation activities are described. The site operations section includes a project organization chart and delineates the responsibilities of key field and office team members. A schedule will be included that shows the proposed scheduling of each major field activity.

The QAPP will cover all expected field activities at the site, including vapor sampling. Minor changes to the QAPP will be documented on a Field Change Notice (FCN) form and submitted in a letter to the EPA RPM and EPA QA officer. Major changes may require an amendment to the QAPP.

Other QA/QC Activities

QA activities to be performed during the implementation of this work plan may include internal office and field or laboratory technical systems audits, field planning meetings, and QA reviews of all project plans, measurement reports, and subcontractor procurement packages. The QA requirements are discussed further in Section 4.2 of this work plan.

Green Remediation Plan

CDM Smith will prepare a site-specific green remediation plan detailing the green remediation elements and best management practices (BMPs) that will be implemented during the RI/FS. The plan will describe the specific activities and practices that will be implemented to maximize sustainability, reduce energy and water usage, promote carbon neutrality, and promote industrial materials reuse and recycling. The green remediation plan will be submitted to EPA. CDM Smith will maintain records of "green-related" activities, and report this information to EPA in regular monthly progress reports or as requested by EPA.

3.1.8 Health and Safety Plan

CDM Smith will prepare a HSP in accordance with 40 Code of Federal Regulations (CFR) 300.150 of the NCP and 29 CFR 1910.120 (1)(1) and (1)(2). The HSP includes the site-specific information listed below.

- Hazard assessment
- Training requirements
- Definition of exclusion, contaminant reduction, and other work zones
- Monitoring procedures for site operations
- Safety procedures
- Personal protective clothing and equipment requirements for various field operations
- Disposal and decontamination procedures
- Other sections required by EPA

The HSP also includes a contingency plan which addresses site specific conditions which may be encountered.

In addition to the preparation of the HSP, health and safety (H&S) activities will be monitored throughout the field investigation. The HSP will specify air monitoring procedures in the exclusion zone established around the drilling rig or sampling locations. A qualified H&S coordinator, or designated representative, will attend the initial field planning meeting and may perform a site visit to ensure that all H&S requirements are being adhered to. A member of the field team will be designated to serve as the onsite H&S coordinator throughout the field program. This person will report directly to both the Field Team Leader (FTL) and the H&S coordinator. The HSP will be subject to revision, as necessary, based on new information that is discovered during the field investigation.

3.1.9 Non-RAS Analyses

Non-RAS analyses are summarized in Section 3.4.3.

3.1.10 Meetings

CDM Smith will participate in various meetings with EPA during the course of the work assignment. As directed by EPA's SOW, CDM Smith has assumed eight meetings, with two people in attendance, for four hours per meeting. Six of these meetings will be held in Puerto Rico and two will be held in New York. CDM Smith will prepare minutes which list the attendees and summarize the discussions in each meeting. It is anticipated CDM Smith will prepare for and attend the meetings listed below.

- Meeting 1 - Field investigation start-up meeting
- Meeting 2 - Post-existing well investigation meeting
- Meeting 3 – Post PSA investigation meeting
- Meeting 4 - Pre-Draft RI report meeting
- Meeting 5 – PAR meeting
- Meeting 6 - Pre-FS meeting
- Meeting 7 - Final FS Meeting
- Meeting 8 - Post-FS Meeting

3.1.11 Subcontract Procurement

This subtask will include the procurement of all subcontractors required to complete the field investigation activities. Procurement activities include: preparing the technical SOW; preparing Information for Bidders (IFB) or Request for Proposal (RFP) packages; conducting pre-bid site visits (when necessary); responding to technical and administrative questions from prospective bidders; performing technical and administrative evaluations of bid documents; performing the necessary background, reference, insurance, and financial checks; preparing consent packages for approval by the EPA CO (when necessary); and awarding the subcontract.

To support the proposed field activities, the following subcontractors will be procured.

- A licensed driller to drill groundwater screening borings, soil borings, and install and develop overburden and multiport bedrock monitoring wells
- Borehole geophysics subcontractor
- FLUTe System installer for hydraulic profiling and multiport groundwater monitoring systems
- A local analytical laboratory subcontractor in Puerto Rico to perform fast turnaround non-RAS analyses described in Section 3.4 (PSA investigations) and on Table 3-10
- A licensed surveyor to survey the location and elevation of existing features (e.g., surface water locations, existing groundwater supply wells, and bedrock outcrops) and all monitoring wells that will be installed during the RI/FS. Because the site area is large and the location of the source (s) is unknown, a detailed topographic map will not be produced for the site. The locations of all sampling points and monitoring wells will be displayed on existing ortho-rectified aerial photographs.
- A cultural resources subcontractor to conduct a Phase IA survey of the local area.
- A subcontractor to haul and dispose of IDW, to remove and properly disposal of roll-off containers and storage tanks containing RI generated waste liquids and solids.

All subcontractor procurement packages will be subject to CDM Smith's technical and QA reviews. If EPA determines that matrix diffusion testing should be conducted, CDM Smith will procure the services of Stone Environmental to conduct this work. Costs for this procurement are not included in this work plan.

3.1.12 Subcontract Management

The SM and CDM Smith's subcontracts managers will perform the necessary oversight of the subcontractors (identified under Section 3.1.11) needed to perform the RI/FS. CDM Smith will institute procedures to monitor progress, and maintain systems and records to ensure that the work proceeds according to the subcontract and RAC requirements. CDM Smith will review and approve subcontractor invoices and issue any necessary subcontract modifications.

3.1.13 Pathway Analysis Report

In accordance with Office of Solid Waste and Emergency Response (OSWER) Directive 9285.7-47 entitled Risk Assessment Guidelines for Superfund (RAGS) - Part D (2001), CDM Smith will provide EPA with standard tables, worksheets, and supporting information for the baseline human health risk assessment (HHRA).

The PAR will consist of RAGS Part D Standard Tables 1 through 6 series and supporting text. The PAR will summarize the key assumptions regarding potential receptors, exposure pathways, exposure parameters, and chemical toxicity values that will be used to estimate risk in the baseline HHRA. Because RAGS Part D Tables 2 and 3 series summarize site data, these tables for the PAR will be prepared after analytical data collected during the RI site investigation are available.

The PAR will be performed in accordance with EPA guidance set forth in the documents listed below.

- *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A* (EPA 1989)
- *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (EPA 2001)
- *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment* (EPA 2004)
- *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part F, Supplemental Guidance for Inhalation Risk Assessment (EPA 2009a)*
- *Exposure Factors Handbook (current edition)*
- *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (EPA 1991b)*
- *Integrated Risk Information System (IRIS) (EPA on-line data base of toxicity values http://www.epa.gov/iris)*

- *EPA Regional Screening Levels for Chemical Contaminants at Superfund Sites (EPA November 2011d or most recent version)*
- *ProUCL Version 4.1 User's Guide (EPA 2010a or most recent version)*
- *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor intrusion Guidance)* (EPA 2002 or most recent version)

Additional guidance which addresses site-specific issues and chemical contaminants will also be consulted with EPA Region 2.

CDM Smith will perform the following activities under this subtask, which will form the basis for the PAR.

3.1.13.1 Data Evaluation

CDM Smith will review available sample information on the hazardous substances present at the site, and identify the COPCs. The selection of COPCs to be used in the risk assessment will be selected in accordance with EPA Region 2 procedures as presented in RAGS Part A. Additional selection criteria that will be used to identify the COPCs at the site are listed below.

- Frequency of detection in analyzed medium (e.g., groundwater)
- Historical site information/activities
- Chemical toxicity
- Risk-based concentration screen using EPA Regional Screening Levels (RSLs) (EPA May 2012 or most recent version) and medium-specific chemical concentrations (i.e., maximum concentrations)

Calcium, magnesium, potassium, and sodium are essential nutrients and are not evaluated as COPCs in health risk assessments.

3.1.13.2 Exposure Assessment

Exposure assessment involves the identification of the potential human exposure pathways at the site for current and potential future land-use scenarios. Potential release and transport mechanisms will be identified for contaminated source media. Exposure pathways will be identified that link the sources, types of environmental releases, and environmental fate with receptor locations and activity patterns. Generally, an exposure pathway is considered complete if it consists of the elements listed below.

- A source and mechanism of release
- A transport medium
- An exposure point (i.e., point of potential contact with a contaminated medium)

- An exposure route (e.g., ingestion) at the exposure point

All current and future land-use scenario exposure pathways considered will be presented; however, only some may be selected for quantitative analysis. Justifications will be provided for those exposure pathways retained and for those eliminated. For the purposes of HHRA, potential source areas are considered onsite. Areas outside of the potential source areas but within the site plume are considered offsite. Potential receptors are presented in Figure 3-4 and summarized below.

Current Land Use Scenario:

Potential Source Areas – Workers and Trespassers (adolescents [12 to 18 years old])

Offsite – Workers, Farmers, Residents (adults and young children [0 to 6 years old]), School Staff and Children (adults, adolescents [12 to 18 years old], children [6 to 12 years old], and young children [0 to 6 years old])

Future Land Use Scenario (assuming land use will remain except that potential source areas may be developed into residential properties):

Potential Source Areas – Workers, Residents (adults and young children [0 to 6 years old], Construction Workers, and Trespassers (adolescents [12 to 18 years old])

Offsite – Workers, Farmers, Resident (adults and young children [0 to 6 years old]), School Staff and Children (adults, adolescents [12 to 18 years old], children [6 to 12 years old], and young children [0 to 6 years old])

Exposure point concentrations (EPCs) will be estimated for each COPC in the risk assessment for use in the calculation of daily intakes. The EPC is the 95 percent or higher upper confidence limit (UCL) on the mean concentration or the maximum detected concentration, whichever is lower. ProUCL version 4.1 (EPA 2010a or most recent version) will be used to calculate UCL.

Daily intakes will be calculated for all exposures. These daily intakes will be used in conjunction with toxicity values to provide quantitative estimates of cancer risk and non-cancer effects. Exposure assumptions used in daily intake calculations will be based on information contained in EPA guidance, site-specific information, and professional judgment. These assumptions are generally 90th and 95th percentile parameters, which represent the reasonable maximum exposure (RME). The RME is the highest exposure that is reasonably expected to occur at a site. If potential risks and hazards exceed EPA target levels (i.e., cancer risk range of 1×10^{-6} to 1×10^{-4} or hazard index [HI] of 1) then central tendency exposures (CTE) will be evaluated using 50th percentile exposure parameters.

The exposure assessment will identify the magnitude of actual or potential human exposures, the frequency and duration of these exposures, and the routes by which receptors are exposed. The assumptions will include information from the *Standard Default Assumptions Guidance* (EPA 1991b) and the *Exposure Factors Handbook: 2011 Edition* (EPA 2011a). Site specific information will be used where appropriate to verify or refine these assumptions. In developing the exposure assessment, CDM Smith will develop reasonable maximum estimates of exposure for both current land use conditions and potential future land use conditions at the site.

3.1.13.3 Toxicity Assessment

The toxicity assessment will present the general toxicological properties of the selected COPCs using the most current toxicological human health effects data. Those chemicals which cannot be quantitatively evaluated due to a lack of toxicity factors will not be eliminated as COPCs on this basis. These chemicals will be qualitatively addressed for consideration in risk management decisions for the site.

Chemical toxicity values used will be obtained from a variety of toxicological sources according to a hierarchy established in the OSWER Directive 9285.7-53 (EPA 2003). The toxicity values hierarchy is as follows:

- Tier 1 – EPA's IRIS
- Tier 2 – EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs): The Office of Research and Development/National Center for Environmental Assessment (NCEA)/Superfund Health Risk Technical Support Center develop PPRTVs on a chemical-specific basis when requested by EPA's Superfund program
- Tier 3 - Other Toxicity Values: Tier 3 includes additional EPA and non-EPA sources of toxicity information. Priority will be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer-reviewed

COPCs are quantitatively evaluated on the basis of their non-cancer and/or cancer potential. The reference dose (RfD) and reference concentration (RfC) are the toxicity values used to evaluate non-cancer health hazards in humans. Inhalation unit risk (IUR) and slope factor (SF) are the toxicity values used to evaluate cancer health effects in humans. A SF is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime and is usually the upper 95 percent confidence limit of the slope of the dose-response curve expressed in $(mg/kg/day)^{-1}$. A slope factor is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen. The IUR is the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to a chemical at a concentration of 1 microgram per cubic meter ($\mu g/m^3$) in air.

For the evaluation of non-cancer effects in the risk assessment, chronic and sub chronic RfDs or RfCs are used. A chronic RfD/RfC is an estimate of a daily exposure level for the human population, including sensitive sub-populations, that are likely to be without appreciable risk of deleterious effects during a lifetime. Chronic RfDs/RfCs are generally used to evaluate the potential non-cancer health effects associated with exposure periods between six years and a lifetime. Sub-chronic RfDs/RfCs aid in the characterization of potential non-cancer effects associated with shorter-term exposure (i.e., less than seven years).

3.2 Task 2 Community Involvement

CDM Smith will provide technical support to EPA during the performance of the following community involvement activities throughout the RI/FS in accordance with the *Superfund Community Involvement Handbook* (EPA 2005).

3.2.1 Community Interviews

CDM Smith performed the activities listed below.

- Preparation for Community Interviews - CDM Smith reviewed background documents and provided technical and bilingual support to EPA in conducting community interviews with government officials (federal, Commonwealth, town, or city), environmental groups, local broadcast and print media.
- Questions for Community Interviews - CDM Smith prepared draft interview questions in both Spanish and English for EPA's review. Final questions reflected EPA's comments on the draft questions.

3.2.2 Community Involvement Plan

CDM Smith translated the community interviews into English. Per EPA direction, no additional work will be performed under this subtask.

3.2.3 Public Meeting Support

CDM Smith will perform the following activities to support two public meetings.

- Make reservations for a meeting space, in accordance with EPA's direction
- Attend two public meetings and prepare draft and final meeting summaries
- Reserve a court reporter for each of the two public meetings
- Provide full-page and "four on one" page copy of meeting transcripts, five additional copies of the transcripts, and an electronic copy of each transcript in Microsoft Word 2007 or latest version

CDM Smith will develop draft visual aids (i.e., transparencies, slides, and handouts) as instructed by EPA. CDM Smith will develop final visual aids incorporating all EPA comments. For budgeting purposes, CDM Smith will assume 35 slides and 75 handouts for each public meeting. The handouts will be prepared in English and Spanish.

3.2.4 Fact Sheet Preparation

CDM Smith will prepare draft information letters/updates/fact sheets. CDM Smith will utilize an existing fact sheet for the site (to be provided by EPA) as the basis for revising, editing, laying out, and photocopying two supplemental fact sheets. The fact sheets will be written in both English and Spanish. CDM Smith will attach mailing labels to the fact sheets before delivering them to EPA from where they will be mailed. For budgeting purposes, CDM Smith will assume two fact sheets (one for each public meeting), two to four pages in length, with three illustrations per fact sheet. CDM Smith assumes 150 copies of each fact sheet will be provided to EPA. Final fact sheets will reflect EPA's comments.

3.2.5 Proposed Plan Support

In accordance with the SOW, this subtask is currently not applicable to this work assignment.

3.2.6 Public Notices

CDM Smith will prepare newspaper announcements/public notices for two public meetings, for inclusion in the most widely read local newspapers, with each ad placed in two large, area-wide newspapers and one small town local newspaper. Two public announcements/notices will be prepared in both English and Spanish for two public meetings.

3.2.7 Information Repositories

In accordance with the SOW, this subtask is currently not applicable to this work assignment.

3.2.8 Site Mailing List

Per EPA direction, this subtask is not part of the scope of work.

3.2.9 Responsiveness Summary Support

CDM Smith will provide administrative and technical support for the site Responsiveness Summary. The draft document will be prepared by compiling and summarizing the public comments received during the public comment period on the Proposed Plan. CDM Smith will prepare technical responses for selected public comments for EPA review and use in preparing formal responses. CDM Smith assumes 75 separate comments will be received and that 75 technical responses will be necessary.

3.3. Task 3 Field Investigation

This task includes all activities related to implementing RI/FS field investigations at the site. The main objectives of the field program are summarized below.

- Define the nature and extent of groundwater and soil contamination at the Cabo Rojo site, including the PSAs and the production wells.
- Identify and investigate potential sources of groundwater contamination. Information from previous investigations and data gathered from the site reconnaissance will be used to identify potential sources.
- Refine the preliminary CSM based on an understanding of the hydrogeologic framework and the location of potential sources.
- Identify and quantify potential human health and ecological risks, if any, posed by exposure to contaminated groundwater, surface and subsurface soil.
- Provide adequate data for development of remedial alternatives in the FS.

Based on these objectives the task descriptions have been developed after review and evaluation of the site background data currently available and the SOW provided by EPA. The major elements of the field investigation include the activities listed below, in the approximate order they will occur in the field.

- Site Reconnaissance (Section 3.3.1)
- Continuous Water Level Monitoring (Section 3.3.3.1.1)
- Mobilization/Demobilization (Section 3.3.2)
- Field Investigation
    - Existing production well evaluation (Section 3.3.3.1.1)
    - PSA investigations (Section 3.3.4)
    - Overburden monitoring well installation (Section 3.3.3.1.2)
    - Multiport well installation (Section 3.3.3.1.2)
    - One round of groundwater sampling (Section 3.3.5.2)
    - Surface Water/Sediment Sampling (Section 3.3.5.3)
    - Ecological Characterization (Section 3.3.6)
    - IDW sampling and disposal (Section 3.3.8)

The technical approach to the field investigation was outlined in Section 2.4; field activities, investigation staging, media to be investigated, and anticipated laboratory analyses are described below. Proposed field sampling locations are presented on Figures 3-1 to 3-3 and the field investigations and sampling activities associated with each portion of the field program are summarized on Tables 3-1 through 3-10.

Use of a dynamic approach requires some flexibility in development of the work plan and execution of the field investigation, largely because of uncertainties derived from a process that uses expedited turnaround times and preliminary data to focus and refine subsequent investigation activities. Therefore, it was necessary to make assumptions about the quantities for planned activities. For example, the number of ports required for a given multiport monitoring well depends on a number of factors including the final depth of the well, location of water bearing zones, and vertical distribution of contaminants obtained from fracture zone sampling. Assumptions made for each stage of work are clearly defined in this work plan. The rationale and decisions required to determine the actual quantities are also defined for activities that depend on evaluation of data from previous activities. Continuous evaluation of data as it becomes available may change aspects of the field investigations.

The task structure and order of discussion of tasks/subtasks in Section 3.3 of this work plan is defined by the SOW; it does not reflect the proposed sequence of field activities.

Investigation Sequencing

Because of the limitations of the existing data and the lack of a defined source of contamination at the Cabo Rojo site, the initial field activities will be sequenced to focus and refine subsequent data collection activities. For example, evaluating information from the existing production wells will determine the hydrogeologic framework and support the CSM. The field program sequence is designed to efficiently fill gaps in the existing information. It also provides flexibility to focus the investigation on potential source areas should they be identified in the early stages of the investigation. For example, identification of source areas is a contingent part of the field plan, to be executed only if field observations point toward a source. This is particularly appropriate for the Cabo Rojo site where existing hydrogeologic information is limited and the sources of contamination have not been identified. The proposed sequence for the major field activities is provided below.

Well Naming Conventions

A number of monitoring wells, existing wells, and public supply wells are referred to in subsequent sections of this work plan. For clarity and consistency, the naming conventions cited below are used to refer to the wells.

- Public supply wells – The PRASA Ana Maria, Club de Leones, Cabo Rojo (3 wells), Hacienda de la Margarita, and Remanso wells that are part of the Cabo Rojo public water supply system (Figure 1-1).
- Multiport monitoring wells – This term refers to bedrock boreholes that exist or will be drilled during the field investigation and subsequently will be fitted with multiport monitoring well systems. The multiport wells will monitor the bedrock aquifer (Figure 3-3).
- Overburden wells – This term refers to conventional wells with one screen interval that will be drilled during the field investigation to monitor contaminants in the overburden.

Field Investigation

1. <u>Existing Production Well Evaluation</u> - Objective: Define the hydraulic properties of geologic formations and Identify fractures and water flow zones within the bedrock and determine where contamination is located within the aquifer.
2. <u>Continuous Water Level Measurements</u> - Objective: Evaluate the effects of production well pumping on the water levels and overall hydrogeology in the bedrock aquifer.
3. <u>PSA Evaluations</u> – Objective: Characterize contaminants in soil and groundwater in potential source areas. Determine whether VOCs are present in groundwater below potential source areas.
4. <u>Overburden Monitoring Wells</u> – Objective: Monitor groundwater contamination within the overburden at PSAs.
5. <u>Multiport Monitoring Well Installation</u> – Objective: Provide data on the vertical and lateral distribution of contaminants in the bedrock aquifer and evaluate potential connections between the PSAs and the production wells.

6. Borehole Geophysics and Discrete Interval Sampling – Objectives: Borehole geophysics will provide data to define the lithology, fracture zones, vertical flow, and water bearing zones to support multiport well installation and to refine the CSM. Discrete interval groundwater sampling will provide screening-level VOC data at discrete depths to evaluate the vertical distribution of VOCs and to support multiport monitoring well design.

7. Hydraulic Testing Using FLUTe Liners – Objective: Provide hydraulic conductivity estimates for the fractured bedrock boreholes.

8. Surface Water and Sediment Sampling- Objective: Characterize the nature and extent of site-related contaminants in storm water collection systems at PSAs.

9. One Round of Groundwater Sampling – Objective: Characterize the distribution of groundwater contamination in the bedrock aquifer and overburden/weathered bedrock zone.

The dynamic approach described in this work plan requires significant communication and coordination with the EPA RPM and EPA technical specialists, particularly at decision points during the course of the program. The CDM Smith SM will maintain regular communication with the EPA RPM throughout the field investigation. Technical memoranda will be prepared by CDM Smith and technical meetings will be held to facilitate decision making required during the RI.

Environmental samples will be collected as indicated in the section below for each field activity. Duplicates and MS/MSD samples will be collected at a rate of five percent of the environmental samples, or one per 20 samples per case. If field operations exceed four weeks a new case number may be assigned by EPA and percentages of duplicates and MS/MSD samples may be higher than five percent.

3.3.1 Site Reconnaissance

To complete this RI/FS work plan, CDM Smith conducted an initial site visit to become familiar with local and site-specific conditions. CDM Smith's SM and Geologist conducted a reconnaissance of the site and surrounding area to evaluate logistical issues relevant to the field investigation. Additional site reconnaissance activities will be performed to support mobilization and to prepare for drilling and sampling activities. The following reconnaissance activities are required to support the field activities.

- PSA reconnaissance
- Groundwater monitoring well installation reconnaissance
- Cultural resources survey oversight
- Topographic survey oversight

CDM Smith will take representative photographs to document the reconnaissance activities and significant events and observations during the RI/FS field program. Photographs will be organized by date and time. An electronic record on a compact disk of the photographs will be placed in the project file and provided to EPA.

3.3.1.1 PSA Reconnaissance

The sources of the VOCs detected in samples from the Cabo Rojo public supply wells have not been identified. Reconnaissance will be performed to uncover signs of dumping or other indications of contaminant release that may account for the VOCs detected in wells and boreholes. In addition, informal interviews with local residents and property owners will be conducted during field activities. If evidence is uncovered that suggests the location of a PSA, concurrence with EPA will be received before beginning any source area investigation activities. A total of 10 PSAs will be evaluated: 4 previously identified and evaluated by EPA, 1 PSA partially evaluated by EPA, and 5 new PSAs (Table 3-1 and Figure 3-1). CDM Smith assumes reconnaissance work will be performed at 6 PSAs.

3.3.1.2 Monitoring Well/Borehole Drilling Reconnaissance

CDM Smith will identify the specific locations of monitoring wells following the PSA investigations. The field team will visit proposed well locations to identify and mark exact drilling locations and assess potential logistical issues and physical access constraints for the drill rig. Potential problem locations will be documented and photographed and locations may be adjusted to facilitate access.

It is anticipated that close coordination will be required with property owners and local authorities regarding access and safety issues. EPA (with CDM Smith support under Subtask 3.3.2.1) will be responsible for obtaining access to public and private properties.

Prior to performing any drilling, CDM Smith's drilling subcontractor will request a utility markout to identify the locations of underground utilities. CDM Smith will verify that the utility markout was performed before drilling activities begin.

3.3.1.3 Cultural Resources Survey Oversight

The CDM Smith cultural resources survey subcontractor will conduct a cultural resources survey covering the study area. The Stage 1A Cultural Resources Survey will be prepared in order to determine the presence or absence of cultural resources which may be impacted by the implementation of any remedial actions. The Stage IA survey is the initial level of survey and requires comprehensive documentary research and an initial walk-over reconnaissance and surface inspection. CDM Smith will oversee the on-site activities of the cultural resources subcontractor. This activity will be conducted concurrently with other activities at the site.

3.3.1.4 Topographic Survey Oversight

A topographic map of the site will not be created since the site consists of a large area and a source area has not been identified. An ortho-rectified aerial photograph will be used as the base map for well and sample locations and figure development. Following the PSA investigations and monitoring well installation, well and sample locations will be surveyed. Three elevations will be determined at each well: the ground surface, the top of the inner casing, and the top of the outer casing.

3.3.2 Mobilization and Demobilization

This subtask will consist of property access assistance; field personnel orientation; field office and equipment mobilization and demobilization; and field supply ordering, staging, and transport to the site. It is anticipated that one major mobilization will be required at the beginning of the Investigation and that a major demobilization will be required at the end of the Investigation.

3.3.2.1 Site Access Support

Access to public areas (roads, parks, etc.) and private property will be needed to execute the field investigation. EPA will be responsible for obtaining site access; CDM Smith will assist with any logistical support. Significant access support is anticipated for the field activities listed below.

- Support area identification
- PSA reconnaissance
- Existing well evaluation
- PSA investigations
- Multiport and overburden well installation
- Drainage feature sampling

CDM Smith will provide a list of property owners (public and private) to be accessed during field activities. The list will include the mailing address and telephone number of the property owners. Once EPA has established that access has been granted, investigation activities can begin. CDM Smith will contact and coordinate with property owners and local officials (for work in public areas) to schedule field activities.

3.3.2.2 Field Planning Meetings

Prior to RI field activities, each field team member will review all project plans and participate in a field planning meeting conducted by the CDM Smith SM and RITM to become familiar with the history of the site, site communication protocols, H&S requirements, roles and responsibilities, field procedures, field data collection and management procedures, sample location naming, sample naming, field data management procedures and related QC requirements. The required field data EDDs will be identified and responsibility for preparation will be assigned. The analytical method codes being used in Scribe will be reviewed to ensure that they are consistent with the EQuIS database. All new field personnel will receive a comparable briefing if they do not attend the initial field planning meeting and/or the tailgate kick-off meeting. Supplemental meetings may be conducted as required by any changes in site conditions or to review field operation procedures.

3.3.2.3 Field Equipment and Supplies

Equipment and field supply mobilization will entail ordering, renting, and purchasing all equipment needed for each part of the RI field investigation. This will also include staging and transferring all equipment and supplies to and from the site. Measurement and Test Equipment forms will be completed for rental or purchase of equipment (instruments) that will be utilized to collect field measurements. The field equipment will be inspected for acceptability, and instruments calibrated as required prior to use. This task also involves the construction of a decontamination area for sampling equipment and personnel. A separate decontamination pad will be constructed by the drilling subcontractor for drilling equipment.

Field Trailer, Utilities, and Services

EPA will assist with finding a suitable location for the command post area. Arrangements for the lease of a field trailer and associated utilities, a secure storage area for IDW, trash container, and portable sanitary facilities will be made. The command post area must be large enough to accommodate a 40-foot office trailer, at least one 20-cubic-yard roll-off container, two 6,500-gallon water tank trucks, portable sanitary facilities, a decontamination area, drilling equipment and supplies, drill rigs and subcontractor support vehicles, and CDM Smith vehicles.

H&S work zones including personnel decontamination areas will be established. Local authorities such as the police and fire departments will be notified prior to the start of field activities. Equipment will be demobilized at the completion of each field event, as necessary. Demobilized equipment will include sampling equipment, drilling subcontractor equipment, H&S equipment, and decontamination equipment.

3.3.2.4 Site Preparation and Restoration

Site Preparation

CDM Smith will ground truth for overhead utilities and surface features around intrusive subsurface boreholes and sampling locations. The drilling subcontractor will be responsible for contacting an appropriate utility location service to locate and mark out underground utilities.

CDM Smith plans to use existing roadway rights-of-way, open space, and clearings to the maximum extent possible to access sampling locations. However, it may be necessary to clear some areas of vegetation in order to access borehole and sampling locations. The drilling subcontractor will be responsible for clearing vegetation. CDM Smith will direct and oversee any necessary clearing activities conducted by the drilling subcontractor.

Site Restoration

Some field activities are expected to occur on private and public properties. In the event that properties are impacted by field activities, the property will be restored, as near as practicable, to the conditions existing immediately prior to such activities. CDM Smith will maintain photographic documentation of site conditions prior to commencement of and after completion of RI field activities.

At the completion of the field activities, decontamination pad materials will be decontaminated and removed from the command post area, unless otherwise instructed by EPA. The decontamination and command post area will be restored, as near as practicable, to its original condition.

Site restoration will be performed by the drilling subcontractor under the direction of CDM Smith personnel who will perform field oversight and H&S monitoring.

3.3.3 Hydrogeological Assessment

This section defines the objectives of the hydrogeological assessment and describes the hydrogeologic investigation activities that will be performed to define the nature and extent of groundwater contamination at the Cabo Rojo site.

Review of existing data indicates significant gaps in the understanding of the nature and extent of groundwater contamination and the hydrogeologic framework at the site. Section 2.4 - Work Plan Approach - describes the technical approach to the hydrogeological investigation; details including field activities, field investigation staging, media to be investigated, and anticipated laboratory analyses are described below.

This work plan includes a dynamic investigation as described in Section 2.4.2. At several points during the overall investigation, data will be evaluated and discussed with EPA to refine and optimize the next steps. The investigation and the decision points are outlined below.

- Existing well evaluations
  - Decision Point - Evaluate data gathered from physical features/existing wells and PSAs before refining the location for multiport wells.
- Install overburden monitoring wells at PSAs
  - Decision Point - Evaluate preliminary results of VOCs in soil and groundwater screening samples. Propose locations for overburden wells at PSAs with VOC contamination.
- Install multiport monitoring wells
  - Decision Point - Evaluate preliminary VOC results in from existing wells and soil and groundwater samples from PSAs. Identify multiport well locations between PSAs and production wells to evaluate contaminant transport.

3.3.3.1 Hydrogeologic Field Investigation

The primary objectives of the hydrogeological field investigations are listed below.

- Determine the source of contamination and characterize the contamination
- Evaluate the hydrogeologic properties of the aquifers
- Support selection of a remedial approach

To support the primary objectives, the hydrogeologic investigation activities shown below will be performed at the site. It should be noted that several activities are optional and will be performed only if authorized separately by EPA.

- Existing well investigation
- Monitoring well installation program
- Retrofit of existing boreholes to multiport wells (Optional)
- Matrix Diffusion Study (Optional)
- Cross-borehole testing (Optional)

3.3.3.1.1 Existing Well Evaluation

Borehole Geophysics

CDM Smith will perform an assessment of three existing wells (Ana Maria, Terminal de Carros Publicos (TCP), and Club de Leones) (Table 3-2 and Figure 3-2). The assessment will evaluate their suitability, both conceptually and technically, for sampling to characterize site contamination. CDM Smith assumes that PRASA will take the wells off-line and remove and replace the pump. The wells will be taken offline approximately 48 hours prior to geophysical logging and water levels will be allowed to stabilize.

At active public supply wells, the assessment may require providing an alternate water source for the public water users for the duration that the well is taken off line. Costs have not been included for an alternate supply of public water. Prior to sampling, water levels will be collected at each of the wells. Geophysical logging instruments will be used to provide data to define the lithology, fracture zones, vertical flow, and water bearing zones of each borehole. The following suite of borehole logs will be run for the purposes indicated.

- Fluid resistivity and temperature under static and pumped conditions (one tool, 2 runs): Data from these logs indicate borehole fluid entry/exit points.
- Natural gamma: Correlate with rock cores to define stratigraphy.
- Optical and acoustic televiewer: Data show borehole wall lithology, strike and dip of fractures and bedding planes.
- Mechanical caliper: Data show borehole wall condition, useful for deciding where to place multiport well ports.
- Vertical flow-static (heat pulse) and pumped (heat pulse) (one tool, 2 runs): Data show fluid entry and exit points and flow rates.

Downhole geophysical logging will be performed by a subcontractor to CDM Smith with experience performing downhole logging. The subcontractor will supply the necessary equipment and personnel to perform the logging. The CDM Smith Hydrogeologist will direct and oversee the subcontractor. The geophysical data will be collected in electronic format and will be analyzed and evaluated by the CDM Smith Hydrogeologist using WellCAD software to determine fracture zones to be targeted for wireline fracture zone sampling and multiport monitoring zones. If necessary, selected geophysical logs will be exported from WellCAD and imported into gINT for use in boring logs and cross sections.

Mechanical caliper, electric, natural gamma, optical televiewer, and acoustic televiewer logs will be run to identify potential water entry/exit points in the borehole. Then the fluid temperature/resistivity and heat pulse flow meter (HPFM) logs will be run under static (ambient) conditions. The resulting fluid temperature and resistivity data and vertical flow data will be used to identify active water entry/exit points. The wireline fluid sampler will then be used to collect samples at the water entry/exits. The goal is to collect samples from zones contributing water to the borehole.

<u>Continuous Water Level Monitoring</u>

Pressure transducers will be deployed in up to 10 existing boreholes to develop an understanding of the overall hydrogeological conditions and the impact of wellfield pumping and to monitor aquifer response to removal of the active production wells from service. The wells to be monitored with pressure transducers will be identified during site reconnaissance. For cost estimating purposes, it is assumed that the transducers will be deployed for 2 months, including 2 weeks prior to the existing well evaluation in order to record water levels under pumped conditions. A transducer will be deployed to record barometric pressure.

<u>Wireline Fracture Zone Sampling</u>

A wireline fluid sampler (Mount Sopris 2FSA-1000) will be used to collect screening-level groundwater samples at water bearing zones or fractures identified using borehole geophysical logs. The objective of the wireline fracture zone sampling is to collect screening-level VOC data in groundwater at discrete depths to evaluate the vertical distribution of contamination for use in site characterization and multiport monitoring well design. A geophysical subcontractor will conduct the geophysical logging and operate the fluid sampler. CDM Smith will provide all bottles, collect the samples, and complete all paperwork and shipping.

After each sample is collected, the remaining water in the sampler will be transferred to a container and water quality parameters including pH, temperature, conductivity, turbidity, and dissolved oxygen will be collected. The sampler will be decontaminated before sampling, between successive samples within the same borehole, and between boreholes. The sampler will be decontaminated following procedures specified in the QAPP.

Fracture zone sampling will be conducted as an integral part of the geophysical logging; therefore, the logging data will be reviewed on an ongoing basis by the CDM Smith Hydrogeologist. The CDM Smith SM and Hydrogeologist will provide recommendations for fracture zone sampling intervals and discuss them with the EPA Hydrogeologist and RPM prior to collecting any samples. Decisions will have to be made on a rapid basis so little to no subcontractor standby time occurs.

It is assumed that 6 samples will be collected to characterize groundwater quality at each of the 3 supply wells, for a total of 18 samples (Table 3-2).

Samples will be analyzed of TCL VOCs through the EPA CLP with a two week turn-around for the preliminary results. Sampling procedures will be detailed in the site-specific QAPP.

3.3.3.1.2 Monitoring Well Installation Program

Following completion of the PSA investigations (described in Section 3.3.4) and after review of the data with EPA, CDM Smith will propose locations for overburden and multiport monitoring wells. CDM Smith assumes that well locations can be determined following each PSA investigation and no demobilization will be required between the PSA investigations and the monitoring well installation.

<u>Overburden Monitoring Well Installation</u>

For cost estimating purposes, CDM Smith assumes that 6 of the 10 PSAs that were evaluated will require overburden monitoring wells. Three wells will be installed at two of the PSAs and two wells will be installed at four PSAs to triangulate the direction of groundwater flow and characterize the site and upgradient conditions, for a total of 14 wells. Well construction methods and materials (including screen slot size, diameter, and filter pack material) detailed below are for cost estimating purposes and may be modified based on the geology encountered during drilling.

Overburden monitoring wells will be installed by the CDM Smith drilling subcontractor using 6¼-inch inner diameter (ID) hollow stem augers. Augers will be advanced until refusal at the top of bedrock (assumed to be 40 feet). The wells will be screened from 30 to 40 feet below the ground surface (bgs) and have 10 foot screens, with screen intervals being determined based on the groundwater screening samples collected during the PSA investigations. Monitoring wells will be constructed of 4-inch diameter polyvinyl chloride (PVC) casing and 0.010-inch slot PVC well screen. It is assumed that wells will be single-cased. The annulus around the well screen will be backfilled with morie #1 sand, which will extend two feet above the well screen. A 2-foot bentonite seal will be placed above the sand pack and the remaining annulus will be grouted to the surface. An 8-inch diameter steel protective casing with a locking cap will be installed and a concrete collar will be poured around the well. Well drilling and construction details will be specified in the site-specific QAPP.

Monitoring wells will be developed to remove drilling fluids, silts, and well construction materials from the well and sand pack and to provide a good hydraulic connection between the well and the aquifer materials. Turbidity, pH, temperature, conductivity, and dissolved oxygen will be monitored during development. Development will continue until all parameters have stabilized (within 10 percent for successive measurements), the water is clear and there is a good hydraulic connection between the wells and the aquifer. In addition, during development flow rates and drawdown will be measured to ensure that the well is sufficiently connected to the aquifer. Well development procedures will be detailed in the site-specific QAPP.

Bedrock Monitoring Well Installation

CDM Smith assumes that five bedrock monitoring wells will be installed to characterize the groundwater between the PSAs and the production wells and the upgradient groundwater conditions (Figure 3-3). For cost estimating purposes, the boreholes will be installed to 200 feet bgs, which is the depth of the Ana Maria production well.

The wells will be installed in order to provide the information listed below.

- Monitor hydraulically productive fracture zones
- Determine the distribution VOCs in groundwater

To complete the well installation program, field tasks will be completed sequentially with each step being completed and data evaluated concurrently, to allow plans for the next portion of the field program to be finalized. This will require close communication between the EPA RPM and CDM Smith team. The following activities will be performed as part of this program.

- Five boreholes will be drilled
- Borehole hydraulic conductivity testing and discreet interval sampling

- Multiport well installation

Borehole Drilling With Air Rotary

The boreholes will be advanced using air rotary drilling methods in the bedrock. Air rotary drilling will be used to advance the borehole through the unconsolidated material to the bedrock using an 8-inch drill bit; a 4-inch diameter carbon steel casing will be tightly sealed into competent bedrock using a cement/bentonite grout slurry. Upon installation of the outer steel casing, the borehole will be advanced through the bedrock using the air rotary with the direct circulation drilling method with a nominal 4-inch (3.78 inch) diameter hammer bit to create a 4-inch borehole.

The on-site geologist will monitor and record the materials brought to the surface. Overburden and rock cuttings will be screened for VOCs.

Borehole Development

Boreholes will be developed to remove fines and drilling fragments from the borehole and to clear borehole fractures. Due to the nature of the drilling technique (air rotary), boreholes are expected to require limited development. However, development will be required to ensure that the boreholes are clean and properly prepared for subsequent downhole logging, fracture zone sampling, and multiport monitoring well installation. Upon reaching terminal depth, the boreholes will be developed by recirculating air down the borehole multiple times to ensure that fines are removed and groundwater is not turbid. Well development procedures will be detailed in the site-specific QAPP. After completion of borehole development, a FLUTe system liner will be installed in the borehole to prevent inter-borehole flow and cross contamination among different fracture zones within the well.

Borehole Geophysics

Following completion of bedrock boreholes, geophysical logging instruments will be used to provide data to define the lithology, fracture zones, vertical flow and water bearing zones of each borehole using the same method as discussed in the Existing Well Evaluation (Section 3.3.3.1.1). Blank FLUTe liners will be inserted into each borehole as it is completed to prevent cross contamination. Liners will be returned to the borehole immediately after completion of the contiguous geophysical testing and wireline sampling. Borehole geophysical logging methods will be detailed in the site-specific QAPP.

Wireline Fracture Zone Sampling

A wireline fluid sampler (Mount Sopris 2FSA-1000) will be used to collect screening level groundwater samples using the same method as discussed in the Existing Well Evaluation (Section 3.3.3.1.1).

It is assumed that 6 samples will be collected from each borehole to characterize groundwater quality associated with water entry/exit points, for a total of 30 samples per borehole (Table 3-3).

Samples will be analyzed for TCL VOCs at a National Environmental Laboratory Accreditation Program (NELAP) laboratory in Puerto Rico with 48 hour turn-around time for the preliminary results. The expedited turn-around time is needed for final selection of port depths. Sampling procedures will be detailed in the site-specific QAPP.

Borehole Hydraulic Conductivity Profiling

When the five boreholes are completed, hydraulic conductivity profiling will be performed. As the FLUTe liner is lowered into the borehole the volume of water being displaced into the fractures and the rate at which it is displaced can be measured to provide hydraulic conductivity estimates of the fractured rock. This testing will be done by the FLUTe subcontractor. Hydraulic conductivity values are depth specific to provide estimates of fracture locations and productivity. Specific details of the profiling method and field personnel necessary to perform the investigation will be included in the QAPP.

Multiport Monitoring Well Installation

CDM Smith performed a technical evaluation of three multiport well vendors for the Cidra Superfund site in Puerto Rico (CDM Smith 2008). Like the Cabo Rojo site, the Cidra site is composed of VOC contaminated public supply wells with no known source(s). The borehole dimensions are the same as those proposed for Cabo Rojo. Installation of the FLUTe multiport systems at the Cidra site was efficient since it arrived pre-manufactured on a roll and was lowered to the pre-determined depth. Groundwater sampling was also efficient since it was possible to purge and sample ports simultaneously, reducing labor costs for sampling. Based on the technical evaluation for the Cidra site, site-specific conditions, project objectives, cost, and experience with the multi-level technology, CDM Smith recommends installation of the FLUTe system at the Cabo Rojo site.

The FLUTe multiport well system will be installed in each of the five bedrock boreholes described above. The results of the geophysical, hydraulic conductivity profiling, and discrete fracture zone sampling detailed above will be used to select the port depths. The port selection will occur in consultation with EPA. For cost estimating purposes it is assumed that 6 ports per well will be installed, for a total of 30 ports. It should be noted that if more than 6 ports are deemed necessary, the wellbore will need to be increased to six inches in diameter.

Upon selection of the intervals to be monitored, the FLUTe multiport well assembly will be lowered inside the borehole. Liners will be used to maintain isolation between sampling ports and to prevent cross contamination. A sampling port will be installed in each monitoring zone. FLUTe multiport monitoring wells will be installed in accordance with manufacturer's instructions. The FLUTe manufacturer will install the wells. The CDM Smith Hydrogeologist will direct and oversee the installation.

In general, multiport monitoring well systems do not allow pumping rates necessary for significant well development after installation. Thorough development of the borehole will be performed before installation of the multiport system. Final multiport well installation procedures will be detailed in the QAPP.

Drilling Waste Management

Drill cuttings and water from drilling operations will be containerized at each drilling location and transported by the drilling subcontractor to a central waste storage area. Liquid wastes will be transferred to 7,000 gallon water tank trucks and drill cuttings will be transferred to 20 cubic yard roll-off containers for subsequent sampling, characterization, and disposal by CDM Smith's IDW subcontractor.

Synoptic Water Level Measurements

To provide data to evaluate groundwater flow, two rounds of synoptic water level measurements will be collected in conjunction with the one round of groundwater sampling. Water level measurements will be taken from the 5 multiport monitoring wells and 14 overburden monitoring wells. Water level data will be managed and stored in the project database as described in Section 3.6.2.

Groundwater Sampling

One round of samples will be collected from the 5 multiport monitoring wells and 14 overburden wells. Sampling will be conducted a minimum of two weeks after development of the wells. Section 3.3.5 provides further details on the monitoring well sampling.

3.3.3.1.3 Retrofit of Existing Boreholes to Multiport Wells (Optional)

Following completion of the PSA investigations and after review of the new data with EPA, CDM Smith will propose existing borehole locations to be retrofitted as multiport monitoring wells. CDM Smith has been informed that approximately 140 bedrock boreholes currently exist in the project area. Borehole locations will be evaluated during the site reconnaissance activity. If any of the existing boreholes are in appropriate locations and conditions are suitable (e.g., depth, diameter) to be retrofitted as multiport monitoring wells, then the existing borehole may be retrofitted as a multiport monitoring well. A significant cost and schedule reduction could be realized if any existing boreholes can replace any of the eight new bedrock wells described in Section 3.3.3.1.2. For purposes of this section, CDM Smith presents our approach for testing and retrofitting existing wells as multiport wells.

Optional costs for this effort are not included because of the high level of uncertainty over the location, depth, condition, and potential for approval from the current well owner for retrofitting wells. If EPA determines any existing wells can be retrofitted, CDM Smith will prepare a work plan letter for submittal to EPA.

Borehole Redevelopment

Boreholes will be redeveloped to remove fines and drilling fragments from the borehole and to clear borehole fractures. Redevelopment will be required to ensure that the boreholes are clean and properly prepared for subsequent downhole logging, fracture zone sampling, and multiport monitoring well installation. The boreholes will be redeveloped by recirculating air down the borehole multiple times to ensure that fines are removed and groundwater is not turbid. Well redevelopment procedures will be detailed in the site-specific QAPP.

Borehole Geophysics

Geophysical logging instruments will be used to provide data to define the lithology, fracture zones, vertical flow and water bearing zones of each borehole using the same method as discussed in the Existing Well Evaluation (Section 3.3.3.1.1). Borehole geophysical logging methods will be detailed in the site-specific QAPP.

Wireline Fracture Zone Sampling

A wireline fluid sampler (Mount Sopris 2FSA-1000) will be used to collect screening level groundwater samples using the same method as discussed in the Existing Well Evaluation (Section 3.3.3.1.1).

Borehole Hydraulic Conductivity Profiling

Hydraulic conductivity profiling will be performed on each of the eight boreholes as described in Section 3.3.3.1.2.

Multiport Monitoring Well Installation

The FLUTe system multiport well system will be installed as described in Section 3.3.3.1.2.

3.3.3.1.4 Matrix Diffusion Study (Optional)

If groundwater concentrations indicate that a fracture or fractures could contain dense non-aqueous phase liquid (DNAPL), a matrix diffusion study will be proposed to EPA. One boring will be cored in the bedrock with an NQ wire-line rock coring bit. The borehole depth will be determined based on the results of the existing well evaluation, but is assumed to be 200 feet bgs for costing purposes. Rock cores will be logged by the CDM Smith Geologist using the rock quality designation (RQD) system and modified Burmeister methods. The cores will be labeled and stored in core boxes.

The rock core will be screened in the field with a photoionization detector (PID) and an ultraviolet (UV) lamp to detect VOCs or the presence of DNAPL. Observations regarding the depths and fractures containing DNAPL will be recorded by the CDM Smith Geologist. The core from an onsite location deemed likely to be contaminated will be used for matrix diffusion sampling. The core will be processed and analyzed by Stone Environmental (under subcontract to CDM Smith) utilizing their proprietary methods. If significant indications of mobile DNAPL are observed in the cores, drilling will be suspended pending discussions with EPA to determine if drilling should be terminated. It may be possible to install an intermediate casing if significant DNAPL is observed to allow continuation of drilling. It may also be necessary to abandon a drilling location if significant DNAPL is encountered and drill at a nearby location (to be determined in the field) to either track significant accumulations of DNAPL or to avoid DNAPL. All such decisions will be coordinated with EPA.

No costs are included in the work plan for matrix diffusion testing. If EPA determines this testing should be conducted, CDM Smith will submit a work plan letter to EPA.

3.3.3.1.5 Cross-Borehole Testing (Optional)

Following completion of the PSA investigations and after review of the data with EPA, CDM Smith will propose existing borehole locations for cross borehole testing to be conducted prior to installation of FLUTe multiport equipment into boreholes. The purpose of cross borehole testing is to evaluate whether or not fractures in one borehole are interconnected with fractures in a nearby borehole. The results can be used to support project objectives such as determining if a groundwater flow path exists between a source and receptor. In its simplest form cross hole testing consists of pumping water from one well and monitoring the response to pumping in another well. Before cross hole testing is conducted a standard set of geophysical borehole logs should be run in each borehole, including caliper, natural gamma, electric logs, fluid conductivity, fluid temperature, optical televiewer, acoustic televiewer, and heat pulse flow meter (ambient and pumped conditions). The logs are analyzed to identify water bearing fractures and zones in the borehole.

If EPA determines that cross borehole testing should be done, CDM Smith will recommend which well(s) should be pumped and the observation well(s) where heat pulse flow meter logs will be collected. If there are no suitably located observation wells, it may be necessary to drill a new well for observational purposes. In the pumped well each zone will be packed off and pumped individually. Packers are used to isolate the zone during pumping to assess the interconnection of each zone individually with zones in the observation well. Heat pulse flow meter data will be collected in the one or more observation wells during pumping of each packed off zone. The heat pulse flow meter readings are taken above and below each zone identified in the observation well in the first geophysical logging program. By comparing the pre-cross hole testing data, the heat pulse flow meter data will identify which fractures respond to pumping from the packed off zone. The heat pulse flow meter log is repeated as each zone in the pumping well is packed off and pumped. The duration and flow rate of pumping from each zone will depend on site conditions but typically consist of 15 to 30 minute on/off cycles. If the recommendation includes multiple observation wells a second heat pulse flow meter may be used so that data can be collected simultaneously from two wells. A qualitative assessment of the degree of interconnectedness of the fracture zones in the wells will be completed following the testing. The assessment would be incorporated in the CSM, the evaluation of groundwater flow and contaminant fate and transport.

No costs are included in the work plan for cross-borehole testing. If EPA determines this testing should be conducted, CDM Smith will submit a work plan letter that provides recommendations and costs for testing locations (including new monitoring wells, if needed) that will provide the required data yet also minimize the need for additional drilling.

3.3.4 Soil Borings, Drilling and Testing

Previous investigations have identified five PSAs. However, based on their locations, these PSAs do not appear to account for all of the contamination detected in the production wells. During the site reconnaissance, additional PSAs will be identified for investigation. For cost estimating purposes, it is assumed that an additional five PSAs will be investigated (Table 3-1). The primary objectives of the PSA soil investigation and groundwater screening investigation are summarized below.

- Identify if residual contamination remains at the PSA
- Identify if PSA contamination can be linked to the production wells
- Define the boundaries of the contamination within the overburden aquifer through groundwater screening

<u>Soil Gas Screening</u>

At the five PSAs that have not been previously fully investigated, soil gas sampling will be performed to evaluate the potential for contamination with PCE, TCE, or DCE. The soil gas samples will be representative of the surrounding soil, and will allow for an evaluation of the PSAs with fewer samples.

Soil gas sample locations will be proposed to EPA based on site observations and historical information collected during PSA reconnaissance. A preliminary list is presented in Table 3-4. Soil vapor boreholes will be drilled using DPT to drive stainless steel rods equipped with a detachable stainless steel drive point to eight feet bgs. Once the desired depth is reached, the drive rod will be retracted to reveal a 6-inch sampling screen attached to dedicated Teflon tubing used to collect the soil vapor samples. At each PSA, soil gas samples will be collected in Tedlar bags and analyzed via field GC. Five percent of the soil gas locations will be sampled for TCL VOCs by collecting a grab sample in a SUMMA canister and submitted to a local non-RAS subcontract laboratory for fast turnaround, confirmatory analysis. If the field screening GC results indicate the presence of VOCs, soil screening will be recommended to EPA.

Upon completion of sampling, the sample tubing will be removed and the temporary soil vapor probe location backfilled with bentonite. Each location will then be marked with a stake/flag labeled with the proper sample identification and illustrated on the site map so that it can be located at a later date. Borings performed in paved or concrete areas will be backfilled and refinished at the ground surface with concrete or cold patch.

Soil Screening

For purposes of this work plan, it is assumed that six PSAs will have detections of VOCs in the soil gas which warrant soil sampling, including the five PSAs which were previously identified and one additional PSA (Table 3-5). Ten soil borings will be advanced at each PSA via DPT, except at PRIDCO West. At this location, because of its size, 20 soil borings are assumed. At each boring location, 4-foot DPT core samples will be collected continuously, starting at the surface and proceeding until bedrock is encountered (assumed to be 40 feet). Upon retrieval from the sampler, each 4-foot sample will be screened for VOCs using a PID. The lithology of each sample will be characterized and logged by the field geologist.

At each boring, soil samples will be collected at 0 to 2 feet and at the water table. A sample will also be collected from the 2-foot interval with the highest PID reading. The water table is assumed to be at approximately eight feet bgs. Sample depths may be modified based on results of the field screening with the PID. For cost estimating purposes it is assumed that 3 soil samples will be collected from each boring. Each soil sample will be analyzed for PCE, TCE, and DCE using a field GC. A 10 cubic centimeter (cm^3) tipless plastic syringe will be used to collect 4 cubic centimeters (cc) of soil, allowing the open end to core the soil. The soil will be extruded into a pre-weighed 40 milliliter (mL) volatile organic analyte (VOA) vial containing 20 mL of distilled, organic-free water. After the soil is added, the vial will be re-weighed in order to determine the concentration of the measured compound in the soil. CDM Smith personnel will operate the GC, which is discussed in Section 3.4.1.

Five percent of the samples will be sent for fast turnaround, confirmatory TCL VOC analysis at a local non-RAS subcontract laboratory. The 6 PSAs will result in a total of 210 samples analyzed by the field GC and 11 confirmatory laboratory samples. A summary of the analyses proposed for each boring is presented in Table 3-5. Sampling procedures will be detailed in the QAPP.

Upon completion of sampling each borehole will be backfilled with bentonite. Each location will then be marked with a stake/flag labeled with the proper sample identification and illustrated on the site map so that it can be located at a later date. The location will be surveyed with a global positioning system (GPS) unit. Borings performed in paved or concrete areas will be backfilled and refinished at the ground surface with concrete or cold patch.

Groundwater Screening

In addition to the soil sampling at each boring, two groundwater screening samples will be collected from two intervals in each soil screening boring to identify groundwater contamination at the six PSAs (Table 3-6). The groundwater screening samples will be collected at the water table and above the bedrock. Once the water table is encountered during soil screening, a DPT probe fitted with a screen will be used to collect a groundwater screening sample. The screen will be decontaminated and redeployed above the water table. For cost estimating purposes it is assumed that two discrete groundwater samples will be collected at 70 borings for a total of 140 samples. Samples will be analyzed for PCE, TCE, and DCE by the field GC; 7 samples will be analyzed for VOCs by the local NELAP laboratory with 48 hour turnaround time.

A peristaltic pump and polyethylene tubing will be used to purge the well point. Purge water will be monitored for pH, conductivity, temperature, dissolved oxygen, and turbidity. Once the monitoring parameters have stabilized samples will be collected using polyethylene tubing fitted with a check valve.

Borehole abandonment is discussed above under soil sampling.

Samples will be analyzed using a field GC for PCE, TCE, and cis-1,2-DCE. Groundwater samples will be collected in clean, unpreserved 40 mL septum capped glass vials with zero headspace. The vials will be capped and inverted to avoid loss of volatiles. Five percent of the samples (seven) will be sent for confirmatory TCL VOC analysis at a NELAP certified local subcontract laboratory. Sampling procedures will be detailed in the QAPP.

Soil Delineation Sampling

Based on the soil and groundwater screening results, soil samples will be collected to delineate the horizontal and vertical extent of soil contamination. For purposes of this work plan, it is assumed that six PSAs will have detections of PCE, TCE, or DCE in the GC soil screening samples which warrant soil sampling. Six soil borings will be advanced at each PSA via DPT. At each boring location, four-foot DPT core samples will be collected continuously, starting at the surface and proceeding until the water table is encountered (assumed to be 12 feet). Upon retrieval from the sampler, each four-foot sample will be screened for VOCs using a PID. The lithology of each sample will be characterized and logged by the field geologist.

At each boring, soil samples will be collected at 0 to 2 feet and at the interval with the highest PID reading. Sample depths may be modified based on results of the field screening with the PID and the results of the soil screening. For cost estimating purposes it is assumed that 2 soil samples will be collected from each boring for a total of 72 samples at 6 PSAs. Each soil sample will be analyzed for TCL VOCs through a CLP laboratory. It is assumed that soil moisture content will be measured as part of the CLP TCL VOC analysis. In addition, one sample per boring will be analyzed for pH, total organic carbon (TOC), and grain size (36 samples for each fraction). It is assumed that pH, TOC, and grain size samples will be analyzed by EPA's DESA laboratory. A summary of the analyses proposed for each boring is presented on Table 3-7. Sampling procedures will be detailed in the QAPP.

3.3.5 Environmental Sampling

Tables 3-2 through 3-9 summarize the number of samples and associated analytical parameters for the various environmental media that will be sampled during the RI. Table 3-10 summarizes all the sampling efforts for this site.

3.3.5.1 Sampling Location and Sample Identification

The location of each sample will determined using either GPS to determine horizontal coordinates or a surveyor to determine horizontal coordinates and elevation. Each location will be given a unique identifier using the following prefixes based on the EPA Region 2 location type and matrix codes. Monitoring well locations and elevations will be surveyed by the surveyor subcontract. All other locations will be surveyed with a GPS unit.

- MW – monitoring well
- MPW – multiport well
- SE – sediment sampling location
- SO – surface soil sampling location
- SW – surface water sampling location
- GS – groundwater screening
- SB – soil boring

Additional location types will be used as required.

Each sample location will be numbered in sequence to produce unique identifiers. A suffix such as S, I, or D may be used to indicate shallow, intermediate, or deep intervals.

Each sample collected at each location will be given a unique sample identifier which will include the location identifier and a suffix to indicate depth interval (A, B, C, etc.), depth range (0-1, 2-4, etc.), or sampling event (R1 – round 1). Background samples will be identified by the suffix "BG" at the end of the sample identifier.

3.3.5.2 Groundwater Sampling

One round of groundwater samples will be collected from the 5 new multiport monitoring wells (30 ports) (Table 3-3) and 14 new overburden monitoring wells (Table 3-8) for a total of 44 samples

Multiport wells will be sampled using the FLUTe specific sampling equipment and procedures. Conventional monitoring wells will be purged with a submersible pump and sampled according to the site-specific, low-flow, minimal drawdown sampling procedure, which follows the EPA SOP "Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling" (EPA 1998b). Groundwater sampling procedures will be fully detailed in the site-specific QAPP.

All groundwater samples will be analyzed for TCL VOCs by a CLP laboratory. To support evaluation of natural attenuation of VOCs in groundwater, 3 samples from each multiport well and 5 overburden wells (20 samples total) will be analyzed for the following parameters: chloride, methane/ethane/ethene (MEE), nitrate/nitrite, sulfate, sulfide, and TOC (EPA 1999a). These 20 samples will also be analyzed for water quality parameters including total suspended solids (TSS), total dissolved solids (TDS), alkalinity, ammonia, hardness, and total Kjeldahl nitrogen (TKN). Dissolved oxygen, oxidation-reduction potential (as Eh), turbidity, temperature, ferrous iron, and conductivity will be measured in the field.

3.3.5.3 Drainage Feature Sampling

The objective of the drainage feature sampling is to evaluate the potential for VOCs from the PSAs to have migrated to the site streams or wetlands. Based on the site visit, the streams in the center of Cabo Rojo are concrete lined. Where natural stream beds are present near PSAs, surface water and sediment samples will be collected if conditions indicate the stream is a likely recipient of contamination from a PSA. If drainage features such as cesspools or catch basins are identified at the PSAs, surface water and sediment samples will be collected and analyzed. For cost estimating purposes, CDM Smith assumes that six of the PSAs will have drainage features available for sampling. Sampling locations will be identified during the site reconnaissance. It is assumed that two surface water and sediment samples will be collected at four PSAs and that three surface water and sediment samples will be collected at two PSAs, for a total of 14 surface water and 14 sediment samples (Table 3-9). Surface water and sediment samples will be analyzed by the CLP for TCL VOCs. Surface water samples will also be analyzed for hardness and sediment samples will be analyzed for TOC, both by DESA.

3.3.5.4 Wetland Sampling and Surface Water/Groundwater Interaction Study (Optional)

If hydrogeological investigations conducted at the site indicate that the groundwater contamination is likely to impact the large wetland area near the site, CDM Smith will develop a sampling program for the wetland area for submittal to EPA. The wetland sampling may include collection of pore water, surface water, and/or sediment samples to determine if contamination from the groundwater is impacting the wetlands. The sampling results will be utilized to evaluate the surface water/groundwater interaction in the wetland area.

No costs are included in the work plan for wetland sampling and surface water/groundwater interaction study. If EPA determines samples should be collected, CDM Smith will submit a work plan letter to EPA.

3.3.6 Ecological Characterization

CDM Smith will perform an ecological characterization at the site which will include a qualitative assessment of general site habitats. If the RI hydrogeological investigations indicate the potential for contamination in the large wetland areas, CDM Smith will discuss options and budgets with EPA prior to the field visit. As part of this task, information regarding the presence of threatened and endangered species, and ecologically sensitive environments that may exist at or in the vicinity of the site will be requested from the appropriate agencies. Prior to field activities, it is anticipated that close coordination will be required with property owners and local authorities regarding access and safety issues. EPA will be responsible for obtaining access to public and private properties.

CDM Smith will provide all analytical data to EPA in Excel format so EPA can complete the SLERA.

3.3.6.1 Habitat Characterization

The purpose of the field effort is to identify site habitats both within and in the vicinity of the site that may potentially be affected by site contaminants. Site conditions and conditions of the adjacent area will be visually inspected. CDM Smith will take representative photographs to document field activities. Observations of general site habitats, wildlife utilization, and contaminant exposure pathways will be made and include the types of information summarized below.

- Vegetation cover types on and in areas immediately adjacent to the site
- Dominant vegetation species and general visual observations of abundance/diversity
- Topographic features (e.g., drainages)
- Location of surface waters and their general aquatic habitat characteristics (e.g., approximate size, flow and direction, bottom substrate, and plant coverage)
- Observations of wildlife use, including (to the extent practicable) species identification and evidence of usage
- Indications of environmental stress that may be related to site contaminants

The results of this characterization will be provided to EPA for inclusion in the SLERA and in the ecological characterization section of the RI report.

3.3.6.2 Identification of Threatened and Endangered Species and Critical Habitats

Information regarding the presence of threatened and endangered species, and ecologically sensitive environments that may exist at or in the vicinity of the site will be requested in writing from EPA and the Puerto Rico Department of Natural and Environmental Resources (PRDNER). Correspondence received will be reviewed and may be used during the ecological reconnaissance to verify agency findings. Agency search results will be presented, summarized, and discussed in the RI report and provided to EPA for the SLERA report.

3.3.7 Geotechnical Survey

This subtask is not required at this time.

3.3.8 Investigation–Derived Waste Characterization and Disposal

CDM Smith will procure a subcontractor to be responsible for the removal and proper disposal of all field generated waste soils, liquids, solids, and personal protective equipment. Representative waste samples will be collected and analyzed by a laboratory to characterize the IDW. CDM Smith will conduct field oversight and H&S monitoring during all waste disposal field activities.

3.4 Task 4 - Sample Analysis

Section 3.3 and Tables 3-2 through 3-10 specify the analyses for each type of samples. Details are summarized below.

Wireline Fracture Zone Borehole Screening Samples: TCL VOCs by CLP (two week turnaround).

PSA Investigation Soil Vapor Screening Samples: PCE, TCE, and DCE by onsite GC. Five percent will be sent to a NELAP certified local subcontract laboratory for fast turnaround, confirmatory TCL VOCs.

PSA Investigation Soil Screening Samples: VOCs by onsite GC. Five percent will be sent to a NELAC certified local subcontract laboratory for fast turnaround, confirmatory TCL VOCs.

PSA Investigation Groundwater Screening Samples: PCE, TCE, and DCE by onsite GC. Five percent will be sent to a NELAC certified local subcontract laboratory for fast turnaround, confirmatory TCL VOCs.

PSA Soil Delineation Sampling: TCL VOCs and soil moisture by CLP and TOC, pH, and grain size by DESA.

Round 1 Groundwater Samples: TCL VOCs by CLP; and chloride, MEE, nitrate/nitrite, sulfate, sulfide, TOC, TSS, TDS, ammonia, hardness, and TKN, by DESA. Ferrous iron analysis will be performed onsite.

Surface Water Samples: TCL VOCs by CLP and hardness by DESA.

Sediment Samples: TCL VOCs by CLP and TOC by DESA.

3.4.1 Innovative Methods/Field Screening Sample Analysis

The soil gas, soil, and groundwater screening samples described in Section 3.3.4 will be analyzed in the field using a portable field GC unit such as a Photovac Voyager or similar GC unit. The Voyager is a portable GC which utilizes a high sensitivity PID and electron capture detector (ECD) for the detection of VOCs in the parts per billion and parts per million concentration ranges. Although the Photovac Voyager Portable GC is designed to accept gas samples only, it is capable of analyzing static headspace above soil and water samples and therefore can be used to screen soil gas, soil, and groundwater samples. The GC unit will be set up with an environmental assay designed to measure VOCs commonly detected in soil gas, soil, and groundwater samples around hazardous waste sites and in leaking underground storage tanks. For the Cabo Rojo site, it is anticipated that the GC unit will be set up to detect TCE, PCE, and DCE only. Before samples are analyzed, the GC will be calibrated with an aqueous standard containing all of the compounds of interest.

Five percent of the environmental samples will be sent to a NELAP certified laboratory for confirmatory TCL VOC analysis. However, to ensure a timely determination that the GC unit is not producing false positive or false negative results, the confirmation samples collected from the first PSA will be submitted for fast turn-around-time analysis (48 hours). The confirmatory analyses will be used to confirm the presence/absence of VOCs; since the matrices will be different, direct comparison of results will not be done.

3.4.2 Analytical Services Provided via CLP or DESA

Sections 3.3.4 and 3.3.5 present the sampling program including those samples to be submitted for analysis by the EPA CLP. Table 3-10 summarizes the sampling program. Samples will be analyzed in compliance with the FASTAC procedure described in Section 2.4.3.

3.4.3 Subcontract Laboratory for Non-RAS Analyses

Samples will be analyzed in compliance with the FASTAC procedure described in Section 2.4.3. If DESA does not have capacity to analyze the non-RAS samples, the samples will be analyzed by a subcontract laboratory. However, this work plan assumes that all analyses except the fast-turnaround VOC samples associated with the PSA investigation will be done through the CLP or by DESA. CDM Smith selected NELAP certified laboratory subcontractors based on their ability to meet SOW specified analytical EPA QA and QC requirements. A project-specific SOW will be prepared for non-RAS analytical services rejected by EPA's DESA laboratory and one of these subcontractors will be selected based on their price for the analyses required. CDM Smith will monitor the subcontractor laboratory's analytical performance.

The number of samples and analytical parameters are defined on Table 3-10. The analytical test methods, detection limits, holding times, parameters, field sample preservation, and QC samples will be provided in the QAPP.

3.5 Task 5 - Analytical Support and Data

EPA will validate all RAS and non-RAS analytical data for the RI and DESA will validate results for their analyses. CDM Smith will not validate the soil vapor screening, soil screening or groundwater screening samples analyzed via the field GC or the confirmatory samples sent to the local subcontract laboratory.

3.5.1 Collect, Prepare and Ship Samples

Sample preparation and shipment is included under Task 3.

3.5.2 Sample Management

The CDM Smith's ASC will be responsible for all RAS CLP laboratory bookings and coordination with the Sample Management Office (SMO), RSCC, DESA, and/or other EPA sample management offices for sample tracking prior to and after sampling events.

For all RAS activities, CDM Smith will notify RSCC and SMO of sample shipments daily to enable them to track samples and to ensure timely laboratory receipt of samples. Sample trip reports will be sent to the RSCC and the EPA RPM within seven working days of final sample shipment.

The CLP laboratories will be responsible for providing organic analytical data packages to EPA for data validation.

Coordination between CDM Smith and the DESA laboratory and/or the subcontract laboratory will be required. All analytical data packages from the subcontract laboratory will be sent directly to CDM

Smith for data validation. The subcontract laboratory will provide analytical data in an EDD format which complies with EPA Region 2 requirements.

The DQTL will log all received analytical EDDs into a project tracking spreadsheet and track the status of each EDD from receipt and validation (if necessary) through upload to EQuIS. If necessary the DQTL will request from RSCC a list of analytical EDDs for the project and will compare this list to the tracking spreadsheet to identify missing EDDs. The DQTL will log all field data EDDs in the same EDD tracking spreadsheet. The DQTL or EQuIS Data Manager (EDM) will update the information about each EDD in the tracking spreadsheet as they are reviewed and uploaded to EQuIS. Any problems with the EDDs will be documented.

3.5.3 Data Validation

All analytical data from the CLP will be validated by EPA. Analytical data from DESA will be validated by DESA. The soil vapor screening, soil screening, and groundwater screening samples analyzed via field GC and the local laboratory will not be validated. These screening results will not be included in the final EDD but will be uploaded into a simple Excel spreadsheet that will be provided to EPA.

3.6 Task 6 - Data Evaluation

This task will begin with the full evaluation of site data. This task will also include efforts related to the compilation of RI analytical and field data collected during field activities which will be loaded into CDM Smith's EQuIS database to meet EPA's Region 2 EDD requirements.

3.6.1 Data Usability Evaluation

CDM Smith will evaluate the usability of the field investigation data including any uncertainties associated with the data. Field sampling techniques, laboratory analytical methods and techniques, audit results, and data validation will all be considered in evaluating the usability of the data. Data usability will be evaluated against the DQOs for the RI and risk assessments, as defined in the QAPP, prior to use in these reports. Any qualifications to the data use will be discussed in the QA section of any reports presenting data.

3.6.2 Data Reduction, Tabulation and Evaluation

CDM Smith will evaluate, interpret, and tabulate data in an appropriate presentation format for final data tables. In accordance with the EPA SOW, the following will be used as general guidelines to prepare data for the RI report.

- Tables of analytical results will be organized in a logical manner such as by sample location number, sampling zone, or some other logical format.
- Analytical results will not be organized by laboratory identification numbers because these numbers do not correspond to those used on sample location maps. The sample location/well identification number will always be used as the primary location code for the analytical results.
- Analytical tables will indicate the sample collection dates.

- The detection limit will be indicated in instances where a parameter was not detected.
- Analytical results will be reported in the text, tables, and figures using a consistent and conventional unit of measurement such as µg/L for groundwater analyses and milligram per kilogram (mg/kg) for soil analyses.
- Protocol for eliminating field sample analytical results based on laboratory/field blank contamination results will be clearly explained.
- If the reported result has passed established data validation procedures, it will be considered valid.
- Field equipment rinsate blank analyses results will be discussed in detail if decontamination solvents are believed to have contaminated field samples.

Detailed information concerning the hydrogeological and physical characteristics of the site and the surrounding area, will be gathered, reviewed, and evaluated for inclusion in the RI report. The purpose of these activities will be to provide detailed descriptions of the site physical features and to assess how these features may impact interpretations regarding groundwater contamination, source areas, and potential migration paths.

Data Management

The DQTL is responsible for coordinating data management tasks. The DQTL works with data providers, the EDM, and the ASC to see that data are managed efficiently, that proper QA/QC procedures are followed, and that the data are ready and available for analysis and reporting. The DQTL, ASC, and EDM will work together to prepare the final project EDD provided to EPA.

During the field investigation various types of data will be supplied by different data providers. The types of data and data providers (in parenthesis) are summarized below.

- Sample analytical data (laboratories)
- Sample and well location and elevation data (CDM Smith or subcontractor)
- Field sample information (date/time of sample collection, from/to interval, analysis performed, sample type, parent sample, etc.) (CDM Smith)
- Field results (water quality parameters, field analytical results) (CDM Smith)
- Water level data (CDM Smith)
- Lithologic data from boring and well installation (CDM Smith)
- Well construction information (CDM Smith)
- Geophysical logging data (subcontractor)
- Base map (CDM Smith or subcontractor)

In general, these data will be stored in EQuIS and can be exported as required to support the analysis and presentation of data using gINT, Microsoft Excel, ArcMAP GIS software, AutoCAD, WellCAD, Surfer, and other applications.

Field sample information, location data (GPS), field results, and water level data will be provided by the CDM Smith field team. The following procedure will be used to prepare field data EDDs, perform necessary QA/QC, and upload the EDDs to EQuIS.

1. Create the EDD. This will be done by project staff under the direction of the DQTL. The DQTL will ensure that the data in the EDD are complete and accurate and comply with EPA Region 2 requirements and valid values. The DQTL will also ensure that all background samples are identified by a sample identifier (ID) and that the remark field notes the duplicate samples and have assigned parent samples.
2. Review with Data Users. The DQTL will review the EDD with key data users to familiarize them with the data, address any questions, and add any information required by the data users.
3. Check EDD in the EQuIS Data Processor (EDP). The DQTL and EDM check that the EDD complies with EPA Region 2 requirements for required fields and valid values. If the EDD does not pass the EDP the problems are addressed by the DQTL.
4. Upload to EQuIS database. Once the EDD passes the EDP the EDM will upload it to the EQuIS database.
5. Check EQuIS database. The DQTL and EDM use database table filters to check for completeness and problems such as missing from/to depth intervals or missing parent sample IDs.

Lithologic data from boring and well installation and well construction information will be completed with gINT software to generate soil boring logs, well construction diagram, and cross sections. Data will be prepared and uploaded to gINT using the process summarized below.

1. Populate the gINT upload template with lithologic and well construction data. Analytical and water level data will be downloaded from EQuIS for use in boring logs, well construction diagrams, and cross sections. Specific geophysical logs will be transferred from WellCAD if needed.
2. Review the data for completeness and accuracy.
3. Upload the data to gINT.

At the conclusion of the project, lithologic and well construction information will be transferred to EQuIS using the EDD creation process outlined above.

Geophysical logging data will be managed using WellCAD software. The subcontractor will provide raw instrument data files and WellCAD files. If necessary, data from some logs, such as natural gamma, will be exported from WellCAD and imported into gINT for use in cross section and boring logs. Borehole geophysical data will not be transferred to the EQuIS database. WellCAD and raw instrument data files can be provided to EPA.

ArcMAP and AutoCAD software will be used by CDM Smith to develop and manage base maps for the project. At the conclusion of the project the final data deliverable provided to EPA will include a site base map in AutoCAD DXF format.

Data Mapping

GIS software will be used to facilitate sample planning, well location selection, data presentation, and sample results. Geologic cross sections will be used to depict data in cross section and will be prepared using gINT software. Graphic illustrations in the data evaluation report and/or the RI report will include geological profiles, cross-sections, and contaminant isoconcentration maps.

CDM Smith will create a project GIS to facilitate planning of field activities, such as well installation and sampling, to conduct spatial analysis of data and to present sample results. The GIS will include layers which depict regional and local cultural and physiographic features such as roads, buildings, water bodies, railroads, and topography.

The GIS will be used to generate plan view maps to support the RI and FS reports, presentations, and public meetings. The GIS will be used to both plan and select sampling locations and to depict actual sample locations. The GIS will be used to prepare potentiometric surface maps and maps depicting the extent of contamination at the site. Box maps will be prepared in Adobe Illustrator using a basemap generated in the GIS.

Electronic Data Deliverable

CDM Smith will prepare an EDD in accordance with EPA Region 2 EDD requirements. The EDD will include the analytical and geologic data generated during the course of the RI.

3.6.3 Modeling (Optional)

Groundwater modeling is not required by EPA at this time. If during the course of this RI/FS a modeling effort is requested by EPA, EPA will issue an amendment to this work assignment. CDM Smith will then perform an initial assessment and submit recommendations to EPA.

For the initial modeling assessment, relevant and available site data will be reviewed, including technical documents/reports and raw data from adjacent (and offsite) areas that may be within the anticipated model domain. Some of the analytical work required to make the assessment will already have been carried out during the RI. The initial modeling assessment will include the activities shown below.

- Review regional hydrogeological setting of the site
- Review site-specific data
  - Nature and extent of contamination
  - Hydraulic properties of the aquifer(s)

- Geometry and lithology of the aquifer(s)

- Identify potential model boundaries and boundary conditions
- Review data accuracy and adequacy
- Prepare recommendations section

Until the initial data review and modeling assessment is carried out, definition of a technical approach for site modeling is considered to be premature. If EPA concurs with any recommendations for modeling, then a detailed work plan and an associated modeling budget will be prepared for EPA's review. This work plan would detail the technical approach and outline specific tasks to be carried out. It would also provide a preliminary conceptual model of the site that would serve as the basis for model development.

3.6.4 Data Evaluation Summary Report

CDM Smith will prepare for and attend a Data Evaluation Summary Meeting with EPA and stakeholders (in lieu of a report) that will present an evaluation of data collected during the RI, including a detailed site conceptual model, identification of data gaps, and identification of potential contaminant source areas or facilities. CDM Smith will prepare and submit to EPA meeting notes documenting comments and specific action items resulting from the meeting. Input and comments from EPA and stakeholders will be recorded and incorporated into the RI Report.

3.7 Task 7 - Risk Assessments

Per EPA direction, this task will not be performed. CDM Smith will provide data for use in the HHRA and SLERA in the standard EPA EDD format under Subtask 3.6.2

3.8 Task 8 - Treatability Study/Pilot Testing

Per EPA direction, this task will not be performed for this site.

3.8.1 Literature Search

Per EPA direction, this subtask will not be performed for this site.

3.8.2 Treatability Study Work Plan

Per EPA direction, this subtask will not be performed for this site.

3.8.3 Conduct Treatability Studies

Per EPA direction, this subtask will not be performed for this site.

3.8.4 Treatability Study Report

Per EPA direction, this subtask will not be performed for this site.

3.9 Task 9 - Remedial Investigation Report

CDM Smith will develop and submit a remedial investigation report that accurately establishes site characteristics including the identification of contaminated media, definition of the extent of contamination in groundwater, soils, surface water, and sediments and delineation of the physical boundaries of contamination. CDM Smith will obtain detailed sampling data to identify key contaminants and determine the movement and extent of contamination in the environment. Key contaminants will be identified in the report and will be selected based on whether they are related to site activities, toxicity, persistence, and mobility in the environment.

3.9.1 Draft Remedial Investigation Report

A draft RI report will be prepared in accordance with the format described in EPA guidance documents such as the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988). A draft outline of the report, adapted from the guidance document, is shown in Table 3-11. This outline should be considered a draft and subject to revision, based on the data obtained. EPA's SOW for this work assignment has provided a detailed description of the types of information, maps, and figures to be included in the RI report. CDM Smith will incorporate such information to the fullest extent practicable.

Upon completion, the draft RI report will be submitted for review by a CDM Smith Technical Review Committee (TRC), followed by a QA review. It will then be submitted to EPA for formal review and comment.

3.9.2 Final Remedial Investigation Report

Upon receipt of all EPA and other federal and Commonwealth written comments, CDM Smith will develop responses to comments, and revise the report prior to submittal to EPA. After EPA approval of the responses, the RI report will be finalized.

3.10 Task 10 - Remedial Alternatives Screening

This task covers activities for the development of appropriate remedial alternatives that will undergo full evaluation. A range of alternatives will be considered, including innovative treatment technologies, consistent with the regulations outlined in the NCP, 40 CFR Part 300, the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA 1989)* and other EPA OSWER directive 9355.4-03 (EPA 1989), EPA OSWER Directive 9283.1-06, *Considerations in Ground Water Remediation at Superfund Sites* (EPA 1992b), as well as other applicable and more recent policies or guidance. CDM will also use EPA's guidance *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites* (EPA 1996), which describes strategies and technologies for groundwater contaminated with chlorinated solvents.

CDM Smith will investigate alternatives that will remediate or control contaminated media related to the site, as defined in the RI, to provide adequate protection of human health and the environment. The potential alternatives will encompass, as appropriate, a range of alternatives in which treatment is used to reduce the toxicity, mobility, or volume of wastes but vary in the degree to which long-term management of residuals or untreated waste is required, and will include one or more alternatives involving containment with little or no treatment, as well as a no-action alternative.

Based on EPA's presumptive remedy guidance (1996), the following alternatives, composed of treatment technologies for potentially affected media at the site, may be selected as representative technologies in the FS alternatives if they are deemed appropriate for chlorinated VOCs.

- Groundwater
  - No Action
  - Institutional/Engineering Controls
  - Hydraulic Control or Containment
  - Groundwater treatment with air stripping, granular activated carbon, chemical/ultraviolet oxidation, permeable reactive barriers, anaerobic biological reactors, and/or other applicable technologies
  - MNA
- Surface Water (if sampled) – It is assumed no alternatives will be developed for surface water.
- Sediment (if sampled) –It is assumed that no alternatives will be developed for sediment.
- Soil
  - No Action
  - Institutional/Engineering Controls
  - Capping
  - Containment
  - Removal/Excavation
  - In-Situ/Ex-Situ Treatment/Fixation
  - Off-site Disposal

Additional applicable technologies may be evaluated after the nature and extent of contamination are determined. Groundwater remedial alternatives will also include several disposal options for treated groundwater (e.g., recharge basins, discharge to a surface water body).

Based on the established remedial response objectives and the results of the risk assessments (Task 7), the initial screening of remedial alternatives will be performed against three criteria: effectiveness, implementability, and relative cost. A brief description of these criteria is presented below.

- Effectiveness - The evaluation focuses on the potential effectiveness of technologies in meeting the remedial action goals; the potential impacts to human health and the environment during construction and implementation; and how proven and reliable the process is with respect to the contaminants and conditions at the site.

- Implementability - This evaluation encompasses both the technical and administrative feasibility of the technology. It includes an evaluation of treatment requirements, waste management, and relative ease or difficulty in achieving the operation and maintenance requirements. Technologies that are clearly unworkable at the site are eliminated.

- Relative Cost - Both capital cost and operation and maintenance cost are considered. The cost analysis is based upon engineering judgment, and each technology is evaluated as to whether costs are high, moderate, or low relative to other options within the same category.

The screening evaluation will generally focus on the effectiveness criterion, with less emphasis on the implementability and relative cost criteria. Technologies surviving the screening process are those that are expected to achieve the remedial action objectives for the site, either alone or in combination with others.

3.10.1 Technical Memorandum

CDM Smith will prepare a draft remedial alternatives screening memorandum that will document all of the analyses and evaluations described above. This draft memorandum will be submitted to EPA for formal review and comment. It will include the information summarized below.

- Establish Remedial Action Objectives - Based on existing information, CDM Smith will identify site-specific remedial action objectives that should be developed to protect human health and the environment. The objectives will specify the contaminant(s) and media of concern, the exposure route(s) and receptor(s), and an acceptable contaminant level or range of levels for each exposure route (i.e., preliminary remediation goals).

- Establish General Response Actions – CDM Smith will develop general response actions for each medium of interest by defining contaminant, treatment, excavation, pumping, or other actions, singly or in combination to satisfy remedial action objectives. The response actions will take into account requirements for protectiveness as identified in the remedial action objectives and the chemical and physical characteristics of the site.

- Identify and Screen Applicable Remedial Technologies - CDM Smith will identify and screen technologies based on the general response actions. Hazardous waste treatment technologies will be identified and screened to ensure that only those technologies applicable to the contaminants present, their physical matrix, and other site characteristics will be considered. This screening will be based primarily on a technology's ability to address the contaminants at the site effectively, but will also take into account that technology's implementability and cost. CDM Smith will select representative process options, as appropriate, to carry forward into alternative development and will identify the need for treatability testing for those technologies that are probable candidates for consideration during the detailed analysis.

- Develop Remedial Alternatives in accordance with the NCP.
    - Screen Remedial Alternatives for Effectiveness, Implementability, and Cost - CDM Smith will screen alternatives to identify the potential technologies or process options that will be combined into media-specific or site-wide alternatives. The developed alternatives will be defined with respect to size and configuration of the representative process options, time for remediation, rates of flow or treatment, spatial requirements, distances for disposal, required permits, imposed limitations, and other factors necessary to evaluate the alternatives. If many distinct viable options are available and developed, CDM Smith will screen the alternatives undergoing detailed analysis to provide the most promising process options.

The technical evaluations completed as part of this task will be summarized and presented to EPA in a technical meeting.

3.10.2 Final Technical Memorandum

As directed by EPA, this subtask is not applicable. EPA's review comments on the draft technical memorandum will be incorporated into the draft FS report under Section 3.12.1.

3.11 Task 11 - Remedial Alternatives Evaluation

Remedial technologies passing the initial screening process will be grouped into remedial alternatives. This task covers efforts associated with the assessment of individual alternatives against each of the nine current evaluation criteria and a comparative analysis of all options against the evaluation criteria. The analysis will be consistent with the NCP, 40 CFR Part 300, and will consider the *Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA* (OSWER Directive 9355.3-01) (EPA 1988) and other pertinent OSWER guidance. The detailed evaluation criteria for remedial alternatives are listed on Table 3-12 and a brief description of each criterion is provided below.

- <u>Overall Protection of Human Health and the Environment</u> - This criterion provides a final check to assess whether each alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under the evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with applicable or relevant and appropriate requirements (ARARs).

- <u>Compliance with ARARs</u> - This criterion is used to determine how each alternative complies with applicable or relevant and appropriate Federal and State requirements, as defined in Section 121 of CERCLA 42 United States Code (USC) Section 9621.

- <u>Long-Term Effectiveness</u> - This criterion addresses the results of a remedial action in terms of the risk remaining at the site after the response objectives have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The factors to be evaluated include the magnitude of remaining risk (measured by numerical standards such as cancer risk levels), and the adequacy, suitability and long-term reliability of management controls for providing continued protection from residuals (i.e., assessment of potential failure of the technical components).

- Reduction of Toxicity, Mobility, or Volume - This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility or volume of the contaminants. The factors to be evaluated include the treatment process employed, the amount of hazardous material destroyed or treated, the degree of reduction expected in toxicity, mobility or volume, and the type and quantity of treatment residuals.

- Short-Term Effectiveness - This criterion addresses the effects of the alternative during the construction and implementation phase until the remedial actions have been completed and the selected level of protection has been achieved. Each alternative is evaluated with respect to its effects on the community and onsite workers during the remedial action, environmental impacts resulting from implementation, and the amount of time until protection is achieved.

- Implementability - This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. Technical feasibility considers construction and operational difficulties, reliability, ease of undertaking additional remedial action (if required), and the ability to monitor its effectiveness. Administrative feasibility considers activities needed to coordinate with other agencies (e.g., Commonwealth and local) in regard to obtaining permits or approvals for implementing remedial actions.

- Cost - This criterion addresses the capital costs, annual operation and maintenance costs, and present worth analysis. Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs. Direct costs include expenditures for the equipment, labor and material necessary to perform remedial actions. Indirect costs include expenditures for engineering, financial and other services that are not part of actual installation activities but are required to complete the installation of remedial alternatives. Annual operation and maintenance costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action. These costs will be estimated to provide an accuracy of +50 percent to -30 percent. A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the current year. This allows the cost of remedial action alternatives to be compared on the basis of a single figure representing the amount of money that would be sufficient to cover all costs associated with the remedial action over its planned life.

- Commonwealth Acceptance - This criterion evaluates the technical and administrative issues and concerns the Commonwealth may have regarding each of the alternatives. The factors to be evaluated include those features of alternatives that the Commonwealth supports, reservations of the Commonwealth, and opposition of the Commonwealth.

- Community Acceptance - This criterion incorporates public concerns into the evaluation of the remedial alternatives. Often, community (and also Commonwealth) acceptance cannot be determined during development of the RI/FS. Evaluation of these criteria is postponed until the RI/FS report has been released for state and public review. These criteria are then addressed in the ROD and the responsiveness summary.

Each remedial alternative will be subject to a detailed analysis according to the above evaluation criteria. A comparative analysis of all alternatives will then be performed to evaluate the relative benefits and drawbacks of each according to the same criteria.

3.11.1 Technical Memorandum

CDM Smith will prepare a draft technical memorandum that addresses the following topics.

- A technical description of each alternative that outlines the waste management strategy involved and identifies the key ARARs associated with each alternative.
- A discussion that describes the performance of that alternative with respect to each of the evaluation criteria. A table will be provided summarizing the results of this analysis. Once the individual analysis is completed, a comparison and contrast of the alternatives to one another, with respect to each of the evaluation criteria, will be performed.

This draft memorandum will be submitted to EPA for formal review and comment. In addition, the technical evaluations completed as part of this task will be summarized and presented to EPA in a technical meeting.

3.11.2 Final Technical Memorandum

As directed by EPA, this subtask is not applicable. EPA's review comments on the draft technical memorandum will be incorporated into the draft FS report under Section 3.12.1.

3.12 Task 12 - Feasibility Study Report

CDM Smith will develop a feasibility study report consisting of a detailed analysis of alternatives and a cost-effectiveness analysis, in accordance with the NCP, 40 CFR Part 300, as well as the most recent guidance.

3.12.1 Draft Feasibility Study Report

CDM Smith will submit a draft feasibility study report to EPA that includes the following detailed information.

- Summary of the RI – CDM Smith will summarize key elements of the RI including the nature and extent of contamination in all site media of concern, the fate and transport factors that affect the identified contamination, and the results of the site risk assessments.
- Establish Remedial Action Objectives.
- General Response Actions.

- Identification of Screening of Applicable Remedial Technologies - EPA may, if applicable, request that CDM Smith develop an analytical flow model to support groundwater flow and plume capture model of the hydrogeologic system at the site and surrounding area.
- Development of Remedial Alternatives in accordance with the NCP - CDM Smith will assemble technologies into remedial alternatives to address the identified contamination at the site.
- Screening of Remedial Alternatives for Effectiveness, implementability, and Cost.
- Development of Detailed Alternative Descriptions - CDM Smith will develop detailed technical descriptions of each alternative that outlines the waste management strategy involved and identifies the key ARARs associated with each alternative.
- Screening Against Evaluation Criteria - CDM Smith will present discussions that describe the performance of each alternative with respect to the evaluation criteria described in Section 3.11. The results of the analysis will be summarized in a table.
- Comparative Evaluation of Alternatives - CDM Smith will compare and contrast the alternatives to one another, with respect to each of the evaluation criteria.

The technical feasibility considerations will include the careful study of any problems that may prevent a remedial alternative from mitigating site problems. Therefore, the site characteristics from the RI will be kept in mind as the technical feasibility of the alternative is studied. Specific items to be addressed will be reliability (operation over time), safety, operation and maintenance, ease with which the alternative can be implemented, and time needed for implementation.

The FS report format is shown on Table 3-13. The executive summary will be a brief overview of the FS and the analysis underlying the remedial actions that were evaluated.

The FS report will be reviewed by a CDM Smith TRC. TRC comments will be addressed prior to submittal to EPA for review.

3.12.2 Final Feasibility Study Report

Upon receipt of all EPA and other federal and Commonwealth written comments, CDM Smith will prepare a response to comments letter prior to revising the FS report for submittal to EPA. After EPA approves the responses, the FS report will be finalized.

3.13 Task 13 Post RI/FS Support

CDM Smith will provide technical support required for the preparation of the ROD, excluding community involvement activities already addressed under Task 2. CDM Smith's support activities will include the items listed below.

- Attendance at public meetings, briefings, and technical meetings to provide site updates
- Review of presentation materials

- Preparation and review of a draft and final Feasibility Study addendum (if required), based on the final ROD adopted for this site, covering issues arising after finalization of the basic RI/FS documents

3.14 Task 14 Administrative Record

In accordance with the SOW, this task is currently not applicable to this work assignment.

3.15 Task 15 Close-out

Project closeout includes work efforts related to the project completion and closeout phase. Project records will be transferred to EPA.

3.15.1 Document Indexing

CDM Smith will organize the work assignment files in its possession in accordance with the currently approved file index structure.

3.15.2 Document Retention/Conversion

CDM Smith will convert all pertinent paper files into an appropriate long-term storage format. EPA will define the specific long-term storage format prior to close-out of this work assignment.

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Section 4
Schedule and Project Management Approach

4.1 Project Schedule

A project schedule for the entire RI/FS scope is included as Figure 4-1. The project schedule is based on assumptions for durations and conditions of key events occurring on the critical and non-critical path as outlined below.

- The schedule for the field activities is dependent on access to all properties being obtained by EPA without difficulty.
- Field activities will not be significantly delayed due to severe weather conditions (i.e., hurricanes) or issues with obtaining access.
- The schedule for the field activities is dependent on timely review and approval of the work plan and QAPP and the provision of adequate funding by EPA.
- The schedule for the field investigation is dependent on all field activities being performed in Level D or Level C personal protective equipment H&S protection.
- CDM Smith will receive validated data for analyses performed by EPA's CLP and DESA eight weeks after sample collection.

4.2 Project Management Approach

4.2.1 Organization and Approach

The SM, Ms. Susan Schofield, P.G., has primary responsibility for plan development and implementation of the RI, including coordination with the RI task manager and support staff, development of bid packages for subcontractor services, acquisition of engineering or specialized technical support, and all other aspects of the day-to-day activities associated with the project. The SM identifies staff requirements, directs and monitors site progress, ensures implementation of quality procedures and adherence to applicable codes and regulations, and is responsible for the established budget and schedule.

The RITM, Mr. Joe Button, P.G., reports to, and will work directly with the SM to develop and coordinate the work plan, QAPP, staffing and physical resource requirements, and technical SOWs for professional subcontractor services. He will be responsible for the implementation of the field investigation, performance tracking of the CDM Smith subcontractor laboratory, the analysis, interpretation and presentation of data acquired relative to the site, preparation of the data evaluation summary report, and the RI report.

The FS task leader (FSTL), Mr. Anthony Isolda, will work closely with the RITM to ensure that the field investigation generates the proper type and quantity of data for use in the initial screening of remedial technologies/ alternatives, detailed evaluation of remedial alternatives, development of requirements for and evaluation of treatability study/pilot testing, if required, and associated cost analysis. The FS report will be developed by the FS technical group.

The FTL, Ms. Frances Delano, P.G., is responsible for on-site management for the duration of all site operations including the activities conducted by CDM Smith, such as equipment mobilization, sampling, and the work performed by subcontractors such as surveying.

The RAC2 Quality Assurance Coordinator (QAC) Ms. Jeniffer Oxford is responsible for tracking implementation of quality requirements and working with project staff to select appropriate quality measures for their work. She also reviews specific task QA/QC procedures, and audits specific tasks. The QAC reports to the CDM Smith Quality Assurance Director.

The QA Director, Ms. Jo Nell Mullins, is responsible for overall quality for the RAC 2, Region 2 contract, and will have approved QACs perform the required elements of the RAC 2, Region 2 QA program of specific task QA/QC procedures, and auditing of specific tasks at established intervals. These QACs report to CDM Smith's corporate QA Director and are independent of the SM's reporting structure.

The ASC, Ms. Vanessa Macwan, will assist staff in defining appropriate analytical requirements consistent with project data quality objectives; assist with preparation or review of subcontract analytical laboratory statements of work; and communicating and resolving analytical issues. The ASC will act as liaison between EPA's RSCC and CDM Smith's field staff, to meet EPA sample management and paperwork requirements.

The DQTL, Ms. Vanessa Macwan, is responsible for coordinating data management tasks and ensuring that all QC checks are implemented. The DQTL works with data providers, the EDM, and the ASC to see that data are managed efficiently, that proper QA/QC procedures are followed, and that the data are ready and available for analysis and reporting. The DQTL, ASC, and EDM will prepare the final project EDD provided to EPA.

The task numbering system for the RI/FS effort is described in Section 3 of this work plan. Each of these tasks has been scheduled and will be tracked separately during the course of the RI/FS work. For the RAC 2 contract, the key elements of the monthly progress report will be submitted within 20 calendar days after the end of each reporting period and will consist of a summary of work completed during that period and associated costs.

Project progress meetings will be held, as needed, to evaluate project status, discuss current items of interest, and review major deliverables such as the work plan, QAPP, the data evaluation summary report, the RI report, the HHRA report, the SLERA report, and the FS report. Figure 4-2 is the project organization chart.

4.2.2 Quality Assurance and Document Control

All work by CDM Smith on this work assignment will be performed in accordance with the *CDM Smith QA Manual Parts 1 and 2, Revision 13* (CDM Smith 2012a and 2012b).

The RAC 2 QAC will maintain QA oversight for the duration of the work assignment. A CDM Smith QAC has reviewed this work plan for QA requirements. A QAPP governing field sampling and analysis is required and will be prepared in accordance with the UFP-QAPP Guidance Manual and the EPA Guidance for QAPPs. It will be submitted to approved technical and QA reviewers for review and approval before submittal to EPA. Any reports which present measurement data generated during the work assignment will include a QA section addressing the quality of the data and its limitations. Such reports are subject to QA review following technical review. SOWs and modifications for subcontractor services and subcontractor bids and proposals will receive technical and QA review.

The CDM Smith SM is responsible for implementing appropriate QC measures on this work assignment. Examples of QC responsibilities are listed below.

- Implementing the QC requirements referenced or defined in this work plan and in the QAPP
- Adhering to the CDM Smith RAC Management Information System (RACMIS) document control system
- Organizing and maintaining work assignment files
- Conducting field planning meetings, as needed, in accordance with the RAC 2 QMP
- Completing measurement and test equipment forms that specify technical and quality equipment requirements

Technical and QA review requirements as stated in the QMP will be followed on this work assignment.

Document control aspects of the program pertain to controlling and filing documents. CDM Smith has developed a program filing system that conforms to EPA's requirements to ensure that the documents are properly stored and filed. This guideline will be implemented to control and file all documents associated with this work assignment. The system includes document receipt control procedures, a file review, an inspection system, and file security measures.

The RAC 2 QA program includes both self-assessments and independent assessments as checks on quality of work performed on this work assessment. Self assessments include management system audits, trend analyses, calculation checking, data validation, and technical reviews. Independent assessments include office, field and laboratory audits and the submittal of performance evaluation samples to laboratories if required.

One QA internal system audit and one field technical system audit are required. A laboratory technical system audit may be conducted by a qualified laboratory auditor. Performance audits (i.e., performance evaluation samples) may be administered by CDM Smith as required for any analytical parameters. An audit report will be prepared and distributed to the audited group, to CDM Smith management, and to EPA. EPA may conduct or arrange a system or performance audit.

4.2.3 Project Coordination

The SM will coordinate all project activities with the EPA RPM. Regular telephone contact will be maintained to provide updates on project status. Field activities at the site will require coordination among federal, Commonwealth, and local agencies and coordination with involved private organizations. Coordination of activities with these stakeholders is described below.

EPA is responsible for overall direction and approval of all activities for the site. EPA may designate technical advisors and experts from academia or its technical support branches to assist on the site. Agency advisors could provide important sources of technical information and review, which the CDM Smith team will use from initiation of RI/FS activities through final reporting.

Sources of technical information include EPA, Puerto Rico Environmental Quality Board (PREQB), PRASA, USGS, and sampling conducted during previous investigations. These sources can be used for background information on the site and surrounding areas.

The Commonwealth, through PREQB, may provide review, direction, and input during the RI/FS. EPA's RPM will coordinate contact with personnel from other agencies.

Local agencies that may be involved include PRASA, and local departments such as planning boards, zoning and building commissions, police, fire, health departments, and utilities (water and sewer). Contacts with these local agencies will be coordinated through EPA.

Private organizations requiring coordination during the RI/FS include residents in the area and public interest groups such as environmental organizations and the press. Coordination with these interested parties will be performed through EPA.

Section 5 References

Agency for Toxic Substances and Disease Registry (ATSDR). 2011. Cabo Rojo Ground Water Contamination Site, Cabo Rojo, Puerto Rico. October.

Calabrese, E.J. and L. A. Baldwin. 1993. Performing Ecological Risk Assessments. Lewis Publishers, Chelsea, MI.

CDM Federal Programs Corporation (CDM Smith). 2012a. Quality Assurance Manual Part 1, Revision 13, May.

CDM Smith. 2012b. Quality Assurance Manual Part 2, Revision 13, September.

CDM Smith. 2008. Technical Evaluation and Recommendation of Multi-level Groundwater Monitoring System, Cidra Groundwater Contamination Site, Cidra, Puerto Rico

CDM Smith. 2012. Technical Scoping Meeting Minutes, Cabo Rojo Groundwater Contamination Site, Cabo Rojo, Puerto Rico. January.

Chapelle, F. H., M. A. Widdowson, J. S. Brauner, E. Mendez III, and C. C. Casey. 2003. Methodology for Estimating Times of Remediation Associated with Monitored Natural Attenuation. U.S. Geological Survey Water Resources Investigations Report 03-4057.

Cox, D.P., and Briggs, R.P. 1973. Metallogenic Map of Puerto Rico: U.S. Geological Survey

Miscellaneous Geologic Investigations Map, 1 p.

Efroymson, R.A., G.W. Suter II, B.E. Sample, and D.S. Jones. 1997. Preliminary Remediation Goals for Ecological Endpoints, Prepared for the Department of Energy by Lockheed-Martin Energy Systems, Oak Ridge National Laboratory. ES/ER/TM/-162/R2. August.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39:20-31.

Maymo-Gatelle, X., Y-T Chien, J. M. Gossett, S.H. Zinder. 1997. Isolation of a bacterium that reductively dechlorinates tetrachloroethene to ethene. Science 276: 1568-1571.

Persaud, D., Jaagumagi, R. and Hayton, A. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. ISBN 0-7729-9248-7. Ontario Ministry of the Environment, Ottawa, Ontario.

Puerto Rico Environmental Quality Board. 2010. Puerto Rico Water Quality Standards Regulation. March.

Rodríguez-Martinez, Jesus. 1996. Hydrogeology and Ground-Water/Surface –Water Relations in the Bajura Area of the Municipio de Cabo Rojo, Southwestern Puerto Rico: U.S. Geological Survey Water-Resources Investigations Report 95-4159. Prepared in cooperation with PRASA.

United States Environmental Protection Agency (EPA). 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final. Office of Solid Waste and Emergency Response, Washington, DC. EPA/540/G-89/004. OSWER Directive 9355.3-01.

_______. 1989a. Risk Assessment Guidance for Superfund: Human Health Evaluation Manual Part A. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington DC. EPA/540/1-89/002. OSWER Directive 9285.701A. NTIS PB90-155581.

_______. 1989b. Rapid Bioassessment Protocols for Use in Streams and Rivers Benthic Macroinvertebrates and Fish. Office of Water. EPA/440/4-89/001. May.

_______. 1991a. Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part B, Development of Risk Based Preliminary Remediation Goals.

_______. 1991b. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. EPA. March 25, 1991.

_______. 1992a. Final Guidance on Data Usability In Risk Assessment (Part A). Office of Solid Waste And Emergency Response Directive 9285.7-09A.

_______. 1992b. Considerations in Ground Water Remediation at Superfund Sites. OSWER Directive 9283.1-06. May 27.

_______. 1993. Guide for Conducting Treatability Studies Under CERCLA November

_______. 1996. Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites. Final Guidance. Office of Solid Waste and Emergency Response. EPA 540/R-96/023 PB96-963508. October.

_______. 1997a. Exposure Factors Handbook, Volumes I, II, and III. Office of Research and Development. EPA/600/P-95/002Fa, -002Fb, and 002Fc.

_______. 1997b. Health Effects Assessment Summary Tables. FY 1997 Update. Office of Solid Waste and Emergency Response. EPA-540-R-97-036. July.

_______. 1997c. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Solid Waste and Emergency Response. EPA 540-R-97-006. OSWER 9285.7-25. PB97-963211. June.

_______. 1998a. Guidelines for Ecological Risk Assessment. Office of Research and Development. EPA/630/R-95/002F. April.

_______. 1998b. Final EPA Region 2 Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling. March 16.

_______. 1999a. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. OSWER Directive Number 9200.4-17P. April.

_______. 1999b. Risk Assessment Guidance for Superfund: Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment Interim Final.

_______. 2001. Requirements for Quality Assurance Project Plans for Environmental Data Operations - EPA QA/R-5 (Final). March.

_______. 2001a. Risk Assessment Guidance For Superfund: Volume I: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments). OSWER Directive Number 9285.7-47. December.

_______. 2001b. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Peer Review Draft. Office of Emergency and Remedial Response. OSWER 9355.4-24. March.

_______. 2001c. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment.

_______. 2002. Draft Guidance for Evaluation the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. EPA530-F-02-052. November.

_______. 2002a. Guidance for Quality Assurance Project Plans. EPA/240/R-02/009. December.

_______. 2003. Human Health Toxicity Values in Superfund Risk Assessments, OSWER Directive 9285.7-53. Office of Solid Waste and Emergency Response. December 2.

_______. 2004. Risk Assessment Guidance For Superfund: Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. Office of Emergency and Remedial Response. OSWER 9285.7-02EP. EPA/540/R/99/005. July.

_______. 2005. Integrated Risk Information System (on-line database of toxicity values). http://www.epa.gov/iris.

_______. 2005a. Superfund Community Involvement Handbook. EPA 540-K-05-003. April.

_______. 2006a. Guidance on Systematic Planning using the Data Quality Objective Process (QA/G-4), EPA/240/B-06/001. http://www.epa.gov/quality/qa_docs.html. February.

_______. 2006b. National Recommended Water Quality Criteria. Office of Water – Office of Science and Technology; 4304T.

_______. 2006c. EPA Freshwater Sediment Screening Benchmarks. http://www.epa.gov/reg3hscd/risk/eco/btag/sbv/fwsed/screenbench.htm. August.

_______. 2009a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part F, Supplemental Guidance for Inhalation Risk Assessment.

_______. 2009b. National Recommended Water Quality Criteria. Office of Water. EPA-822-R-02-047.

_______. 2010. Hazard Ranking System Package, Cabo Rojo Groundwater Contamination Site, Cabo Rojo, Puerto Rico. CERCLIS ID No. PRN000206319. October.

_______. 2010a. ProUCL Version 4.1 User's Guide.

_______. 2011. Comprehensive Electronic Data Deliverable Specification Manual 2. New York, New York. http://www.epa.gov/Region2/superfund/medd.htm. Last accessed June 17, 2011.

_______. 2011a. Electronic Data Deliverables Valid Values Reference Manual. New York, New York. http://www.epa.gov/Region2/superfund/medd.htm. Last accessed June 17, 2011.

_______. 2011b. Basic Manual for Historic Electronic Data. New York, New York. http://www.epa.gov/Region2/superfund/medd.htm. Last accessed June 17, 2011.

_______. 2011c. Standalone EQuIS Data Processor User Guide. New York, New York. http://www.epa.gov/Region2/superfund/medd.htm. Last accessed June 17, 2011.

_______. 2011e. Cabo Rojo Soil Vapor Investigation Results Draft Report. EPA Environmental Response Team.

_______. 2012. EPA Regional Screening Levels. May.

United States Census Bureau. Data Year 2010 Census.

_______.U.S. Geological Survey. 1996. Hydrology and ground-water/surface-water relations in the Bajura area of the Municipio of Cabo Rojo, southwestern Puerto Rico. Water-Resources Investigations Report 95-4159. Prepared in cooperation with Puerto Rico Aqueduct and Sewer Authority (PRASA).

_______.U.S. Geological Survey. 2002. Geology and hydrogeology of the Caribbean islands aquifer system of the Commonwealth of Puerto Rico and the U.S. Virgin Islands: excerpts. USGS Professional Paper 1419.

Vogel, T.M., C.S. Criddle and P.L. McCarty. 1987. Transformations of halogenated aliphatic compounds: Environmental Science and Technology. Vol. 3, No. 8, pp722-736.

Volkman, Richard P. 1984. Geologic Map of the Puerto Real Quadrangle, southwest Puerto Rico: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-1559. 1 p.

Weston. 2007. Pre-CERCLIS Screening Report Data Summary Tables. Cabo Rojo Site Discovery Initiative. Cabo Rojo, Puerto Rico. Prepared for EPA. February.

Table 1-1
Summary of Historical VOC Detections in the Cabo Rojo Urbano Public Supply Wells
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

Well	Sampling Event	PCE (µg/L)	TCE (µg/L)	1,1-DCE (µg/L)	cis-1,2-DCE (µg/L)	Party
Hacienda Margarita	2004-2005	detected	detected	not detected	not detected	PRASA
	2006	not detected	not detected	not detected	not detected	EPA
	2010	not detected	not detected	not detected	not detected	EPA
	2011	not detected	not detected	not detected	2.1	PRASA
	2012	not detected	not detected	not detected	not detected	PRASA
Ana Maria	2002-2006	1.8 - 4.0	0.5 - 1.6	not detected	not detected	PRASA
	2006	1.9	0.62 - 0.63	0.66 - 0.67	not detected	EPA
	2009	1.1	not detected	not detected	not detected	EPA
	2010	1.9	0.7	not detected	not detected	EPA
	2011	3.2	1.1	not detected	1	PRASA
Club de Leones	2006	not detected	not detected	not detected	0.96	EPA
	2010	not detected	not detected	0.9	not detected	EPA
	2011	not detected	not detected	0.8	not detected	PRASA
	2012	not detected	not detected	not detected	not detected	PRASA
Cabo Rojo 1	2006	not detected	not detected	not detected	not detected	EPA
	2009	not detected	not detected	not detected	not detected	EPA
	2010	not detected	not detected	not detected	not detected	EPA
	2011	not detected	not detected	not detected	not detected	PRASA
	2012	not detected	not detected	not detected	not detected	PRASA
Cabo Rojo 2	2006	not detected	not detected	not detected	not detected	EPA
	2009	not detected	not detected	not detected	not detected	EPA
	2010	not detected	not detected	not detected	not detected	EPA
	2011	not detected	not detected	not detected	not detected	PRASA
	2012	not detected	not detected	not detected	not detected	PRASA
Cabo Rojo 3	2006	not detected	not detected	not detected	not detected	EPA
	2009	not detected	not detected	not detected	not detected	EPA
	2010	not detected	not detected	not detected	not detected	EPA
	2011	not detected	not detected	not detected	not detected	PRASA
	2012	not detected	not detected	not detected	not detected	PRASA
Remanso	2006	not detected	not detected	not detected	not detected	EPA
	2008	not detected	not detected	not detected	not detected	PRASA
	2009	not detected	not detected	not detected	not detected	PRASA
	2010	not detected	not detected	not detected	not detected	PRASA
	2011	not detected	not detected	not detected	not detected	PRASA

Abbreviations:
EPA - U.S. Environmental Protection Agency
PRASA - Puerto Rico Aqueduct and Sewer Authority
µg/L - microgram per liter
VOC - volatile organic compound

PCE - tetrachloroethene
TCE - trichlotoethene
DCE - dichloroethene

Table 1-2
Cabo Rojo Area Well Construction and Status
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

Name	Depth of Well	Open or Screened Section Depth Interval	Status
Ana Maria	200 (1)	40-200 (1)	Operating
Club de Leones	150 (1)	90-150 (1)	Operating
Cabo Rojo 1	unknown	unknown	Operating
Cabo Rojo 2	143 (2)	33-143 (2)	Operating
Cabo Rojo 3	143 (2)	33-143 (2)	Operating
Hacienda Margarita	unknown	unknown	Operating
McDougal (4)	175 (1)	50-175 (1)	Wastewater Treatment Plant/Pump Station
Terminal de Carros Publicos	65 (3)	50-65 (3)	Inactive
Weko 1	unknown	unknown	Inactive
Weko 2	unknown	unknown	Inactive
Remanso	unknown	unknown	Operating

(1) taken from Rodriguez-Martinez 1996 (USGS), feet below the land surface

(2) taken from the Hazard Ranking System documentation (EPA 2010), feet below land surface

(3) taken from notes provided by Denise Zeno (EPA) dated January 27, 2012 (Appendix 2), feet below land surface

(4) Notes provided by Denise Zeno indicate this well is closed but was converted into a pump station for incoming water from Mayaguez.

Table 2-1
Potetential ARARS and TBCs
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

Chemical-Specific ARARs	
Federal	**Commonwealth of Puerto Rico**
RCRA Groundwater Protection Standards and Maximum Concentration Limits (40 Code of Federal Regulations (CFR) 264, Subpart F)	Puerto Rico Water Quality Standards - PREQB, Water Quality Standards Regulation, March 28, 2003)
Clean Water Act, Water Quality Criteria (Section 304) (May 1, 1987 - Gold Book)	PRDOH National Primary Regulations of Potable Water, March 1992
Safe Drinking Water Act, Maximum Contaminant Levels (40 CFR 141.11-.16) issued July 1, 1991 and amended in the Federal Register 40 CFR Part 141 issued June 29, 1995. Includes secondary MCLs, which are not enforceable but set standards for aesthetic factors that may affect public acceptance of water	PRDOH General Regulation for Environmental Health, Regulation No. 6090, February 4, 2000
RCRA (toxicity characteristic leaching procedure) TCLP and Land Ban Requirements for Landfilling (40 CFR 261)	
Location-Specific ARARs	
Federal	**Commonwealth of Puerto Rico**
Executive Order on Wetlands Protection (CERCLA Wetlands Assessments) No. 11990	Puerto Rico EQB, Guidelines for Environmental Impact Statements
National Historic Preservation Act (16 United States Code [USC] 470) Section 106 et seq. (36 CFR 800)	Puerto Rico Department of Natural and Environmental Resources, Critical Element and Endangered Species Database, 1998
Endangered Species Act of 1973 (16 USC 1531) (Generally, 50 CFR Part 402)	
RCRA Location Requirements for 100-year Flood Plains (40 CFR 264.18(b))	
Fish and Wildlife Coordination Act (16 USC 661 et seq.)	
Wetlands Construction and Management Procedures (40 CFR 6, Appendix A)	
Executive Order 11990, "Protection of Wetlands"	
1985 Statement of Policy on Floodplains/Wetlands Assessments for CERCLA Action	
Action-Specific ARARs	
Federal	**Commonwealth of Puerto Rico**
RCRA Subtitle C Hazardous Waste Treatment Facility Design and Operating Standards for Treatment and Disposal Systems, (i.e., landfill, incinerators, tanks, containers, etc.)(40 CFR 264 and 265) (Minimum Technology Requirements)	Puerto Rico General Requirements for Permitting Wells
RCRA Ground Water Monitoring and Protection Standards (40 CFR 264, Subpart F)	Puerto Rico EQB, regulation for the Control of Atmospheric Pollution, 1995
RCRA Manifesting, Transport and Recordkeeping Requirements (40 CFR 262)	Puerto Rico EQB, Regulation for the Control of Hazardous and Non-Hazardous Waste, 1982 as amended, 1985, 1986 and 1987
RCRA Wastewater Treatment System Standards (40 CFR 264, Subpart X)	Puerto Rico EQB, Underground Storage Tank Control Regulations, 1990
RCRA Storage Requirements (40 CFR 264; 40 CFR 265, Subparts I and J)	Puerto Rico EQB, underground Injection Control Regulations, 1988
RCRA Subtitle D Nonhazardous Waste Management Standards (40 CFR 257)	
RCRA - Part 260 General Hazardous Waste Management System Regulations (40 CFR Part 260)	
RCRA - Part 261 Identification and Listing of Hazardous Waste (40 CFR Part 261-265, 270, and 271)	
RCRA - Part 262 Standards for Generators. Part 263 Standards for Transporters (40 CFR Parts 262 and 263	
RCRA - Part 264, Subtitle C (40 CFR Part 264)	
Toxic Substances Control Act (TSCA)(40 CFR 761)	

Table 2-1
Potetential ARARS and TBCs
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

Chemical-Specific ARARs	
Federal	**Commonwealth of Puerto Rico**
Off-Site Transport of Hazardous Waste (EPA Office of Solid Waste and Emergency Response [OSWER] Directive 9834.11)	
Clean Water Act – NPDES permitting	
Permitting Requirements for Discharge of Treatment System Effluent (40 CFR 122-125)	
Clean Water Act Discharge to Publicly Owned Treatment Works (POTW) (40 CFR 403)	
National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR 61)	
Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities (29 CFR 1904, 1910, 1926)	
Fish and Wildlife Coordination Act (16 UC 661 et seq.). (Requires actions to protect fish or wildlife when diverting, channeling or modifying a stream)	
National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50)	
The Endangered Species Act	
TBCs	
Federal	**Commonwealth of Puerto Rico**
Safe Drinking Water Act National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs)	Puerto Rico EQB, Guidelines for Environmental Impact Statements
National Recommended Water Quality Criteria, EPA 2006b	PREQB, Soil Erosion Control and Sediment Prevention Regulation
Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario - Lowest Effect Level (LEL) and Severe Effects Level (SEL) (Ontario 1993)	Puerto Rico EQB, Mixing Zone and Bioassay Guideline, 1988
EPA Regional Screening Levels (RSLs), EPA May 2012	Puerto Rico Departmental of Natural and Environmental Resources, Critical Element and Endangered Species Database, 1998
EPA Drinking Water Health Advisories	
Policy for the Development of Water-Quality-Based Permit Limitations for Toxic Pollutants (49 CFR 8711)	
Ground Water Classification Guidelines	
Ground Water Protection Strategy	
Fish and Wildlife Coordination Act Advisories	
Control of Air Emissions from Superfund Air Stripper at Superfund Groundwater Sites (OSWER Directive 9355.0-28)	
Draft Guidance for Evaluation of the Vapor Intrusion to Indoor Air Pathway, EPA 2002	
Waste Load Allocation Procedures	
Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (D. Persaud *et al.*, August 1993)	
Ontario Ministry of the Environment and Energy - LEL and SEL	
EPA Soil Screening Guidance: Technical Background Document, EPA May 1996	
EPA Health Effects Assessment (HEAs)	

Table 2-1
Potetential ARARS and TBCs
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

Chemical-Specific ARARs	
Federal	**Commonwealth of Puerto Rico**
Toxicological Profiles, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service	
Cancer Assessment Group (National Academy of Science) Guidance	
Proposed RCRA Corrective Action Regulations (July 27, 1990)	
Guidelines for the Protection and Management of Sediment Quality in Ontario, Ontario Ministry	
EPA Region 5, Resource, Conservation, Recovery, Act (RCRA) Ecological Screening Levels, 2003	
Consensus-based threshold effects concentrations (TEC), (MacDonald et al. 2000)	

Notes:

ARAR - Applicable Relevant and Appropriate Requirements

CERCLA - Comprehensive Environmental Response, Compensation and Liability Act of 1980

PRDOH - Puerto Rico Department of Health

PREQB - Puerto Rico Environmental Quality Board

RCRA - Resource Conservation and Recovery Act

TBC - "To Be Considered"

Table 2-2
Summary of Data Quality Levels
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

Data Uses	**Analytical Level** [1]	**Types of Analysis**
Site Characterization Monitoring during implementation of field events	Screening level	- Total organic vapor using field instruments - TCE, PCE and DCE using field GC - Water quality field measurements using portable instruments
Risk Assessment Site Characterization	Definitive level	- Organics using EPA-approved methods - CLP SOWs - Standard water analyses - Analyses performed by laboratory
Site Characterization	Screening level with definitive level confirmation Field instrument [2]	- Measurements from field equipment - Qualitative measurements

Notes:

(1) Definitions of analytical levels: Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Screening data provide analyte (or at least chemical class) identification and quantification, although the quantification may be relatively imprecise. For definitive confirmation, approximately 10 percent of the screening data are confirmed using analytical methods and quality control procedures and criteria associated with definitive data. Screening data without associated confirmation data are generally not considered to be data of known quality.

Definitive data are generated using rigorous analytical methods, such as EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods generating definitive data produce tangible raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the quality control requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined.

(2) DQO = Measurement-specific Data Quality Objective requirements will be defined in the QAPP.

Abbreviations:
CLP = Contract Laboratory Program
DQO = data quality objective
DCE = dichloroethene
EPA = Environmental Protection Agency
GC = gas chromatograph
PCE = tetrachloroethene
QAPP = quality assurance project plan
SOW = Statement of Work
TCE = trichloroethene

Table 3-1
Potential Source Area Reconnaissance
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

No.	Potential Source Area Location	Reconnaissance
1	Extasy Q Prints	Completed by EPA
2	Cabo Rojo Professional Dry Cleaners	Completed by EPA
3	D'Elegant Fantastic Dry Cleaners	Completed by EPA
4	Serrano II Dry Cleaners	Completed by EPA
5	PRIDCO East	Partially Completed
6	PRIDCO West	Yes
7	RETO Plant	Yes
8	Raul Lugo	Yes
9	Unfinished Strip Mall	Yes
10	TBD 1	Yes

Abbreviations:
EPA = Environmental Protection Agency
PRIDCO = Puerto Rico Industrial Development Company
TBD = to be determined

Table 3-2
Existing Well Evaluation
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

No.	Well Name[1]	Well Type	Geophysics[2]	Analyses (CLP)[3]	Samples
1	Ana Maria	Supply Well	Yes	TCL VOCs	6
2	Club de Leones	Supply Well	Yes	TCL VOCs	6
3	Terminal de Carros Publicos	Supply Well	Yes	TCL VOCs	6
4	Hacienda Margarita[4]	Supply Well	No	None planned	NA
	Total Samples				**18**

1 Only supply wells that have had detected contamination are listed.

2 Geophysical logs will include natural gamma, specific conductance, temperature, caliper, acoustic televiewer, and heat pulse flow meter.

3 CDM Smith assumes that these samples will be analyzed by CLP (with two-week turn-around time for preliminary results).

4 Since no contamination was identified in recent sampling of this well, it will not be tested.

Abbreviations:

CLP = Contract Laboratory Program
NA = not applicable
TCL = Target Compound List
VOC = volatile organic compound

Table 3-3
Proposed Multiport Monitoring Wells
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

Well Name	Location	Geophysics[1]	Wireline Sampling[2,3]	Round 1 Sampling	
				(CLP)	(CLP/DESA)[4,5]
Multiport 1	between CRPDC, EQP, and Ana Maria	Yes	TCL VOCs	TCL VOCs	MNA parameters
Multiport 2	PRIDCO West	Yes	TCL VOCs	TCL VOCs	MNA parameters
Multiport 3	PRIDCO East	Yes	TCL VOCs	TCL VOCs	MNA parameters
Multiport 4	between Serrano II and PRASA well	Yes	TCL VOCs	TCL VOCs	MNA parameters
Multiport 5	Background south of PRIDCO	Yes	TCL VOCs	TCL VOCs	MNA parameters
Total Samples			**30**	**30**	**15**

[1] Geophysical logs will include natural gamma, specific conductance, temperature, caliper, acoustic televiewer, and heat pulse flow meter.
[2] CDM Smith assumes that wireline samples will be analyzed by a local NELAP lab with 48 hours turn-around time.
[3] CDM Smith assumes that one duplicate and one MS/MSD will be collected from each well.
[4] MNA parameters include: TSS, TDS, alkalinity, ammonia, hardness, TKN, chloride, MEE, nitrate/nitrite, sulfate, sulfide, TOC.
[5] MNA parameters will be collected from 3 ports from each well, for a total of 24 samples.

Abbreviations

CLP Contract Laboratory Program
CRPDC Cabo Rojo Professional Dry Cleaners
DESA Division of Environmental Science and Assessment
EQP Extasy Q Prints
MEE methane/ethane/ethene
MNA Monitored natual attenuation
MS/MSD matrix spike/matric spike duplicate
NELAP National Environmental Laboratory Accreditation Program
PRIDCO Puerto Rico Industrial Development Company
TCL Target Compound List
TDS total dissolved solids
TKN total Kjeldahl nitrogen
TOC total organic carbon
TSS total suspended solids
VOC volatile organic compound

Table 3-4
Potential Source Area Soil Vapor Screening
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

No.	PSA Location[1]	Reconnaissance	Soil Vapor	Analytical (field GC)[2]	Analytical (local laboratory)[3,4]
1	Extasy Q Prints	Complete	Complete	None	None
2	Cabo Rojo Professional Dry Cleaners	Complete	Complete	None	None
3	D'Elegant Fantastic Dry Cleaners	Complete	Complete	None	None
4	Serrano II Dry Cleaners	Complete	Complete	None	None
5	PRIDCO East	Yes	10 locations, 1 sample each	PCE, TCE and DCE	TCL VOCs
6	PRIDCO West	Yes	20 locations, 1 sample each	PCE, TCE and DCE	TCL VOCs
7	RETO Plant	Yes	10 locations, 1 sample each	PCE, TCE and DCE	TCL VOCs
8	Raul Lugo	Yes	10 locations, 1 sample each	PCE, TCE and DCE	TCL VOCs
9	Unfinished Strip Mall	Yes	10 locations, 1 sample each	PCE, TCE and DCE	TCL VOCs
10	TBD A	Yes	None (eliminated via reconnaissance)	None	None
	Total Samples			**60**	**5**

[1] CDM Smith assumes 5 PSAs will require soil vapor screening to evaluate contamination. The actual locations will be determined based on PSA reconnaissance.

[2] CDM Smith assumes 1 duplicate per property.

[3] CDM Smith assumes at least 1 sample per property.

[4] CDM Smith assumes that these samples will be analyzed by a local NELAP certified laboratory on 48 hour turn-around time, except the first PSA, which will be analyzed with 24 hour turn-around time.

Abbreviations:
DCE = dichloroethene
GC = gas chromatograph
NELAP = National Environmental Laboratory Accreditation Program
PCE = tetrachloroethene
PSA = potential source area
PRIDCO = Puerto Rico Industrial Development Company
TBD = to be determined
TCE = trichloroethene
TCL = Target Compound List
VOC = volatile organic compound

Table 3-5
Potential Source Area Soil Screening
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

No.	PSA Location[1]	Soil Screening	Analytical (field GC)[2]	Analytical (Local laboratory)[3,4]
1	Extasy Q Prints	10 borings, 3 samples per boring	PCE, TCE and DCE	TCL VOCs
2	Cabo Rojo Professional Dry Cleaners	10 borings, 3 samples per boring	PCE, TCE and DCE	TCL VOCs
3	D'Elegant Fantastic Dry Cleaners	10 borings, 3 samples per boring	PCE, TCE and DCE	TCL VOCs
4	Serrano II Dry Cleaners	10 borings, 3 samples per boring	PCE, TCE and DCE	TCL VOCs
5	PRIDCO East	10 borings, 3 samples per boring	PCE, TCE and DCE	TCL VOCs
6	PRIDCO West	20 borings, 3 samples per boring	PCE, TCE and DCE	TCL VOCs
7	RETO Plant	None (eliminated via soil vapor screening)	None	None
8	Raul Lugo	None (eliminated via soil vapor screening)	None	None
9	Unfinished Strip Mall	None (eliminated via soil vapor screening)	None	None
10	TBD A	Eliminated via reconnaissance	None	None
	Total Samples		**210**	**11**

[1] CDM Smith assumes 6 PSAs will require soil screening to evaluate soil contamination. The actual locations will be determined based on the sampling results.
[2] CDM Smith assumes duplicate at five percent.
[3] CDM Smith assumes five percent of the GC samples will be analyzed by the local laboratory.
[4] CDM Smith assumes these samples will be analyzed by a local NELAP certified laboratory on 48 hour turn-around time.

Abbreviations:
DCE = dichloroethene
GC = gas chromatograph
NELAP = National Environmental Laboratory Accreditation Program
PSA = potential source area
PCE = tetrachloroethene
PRIDCO = Puerto Rico Industrial Development Company
TBD = to be determined
TCE = trichloroethene
TCL = Target Compound List
VOC = volatile organic compound

Table 3-6
Potential Source Area Groundwater Screening
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

No.	PSA Location[1]	Groundwater Screening	Analytical (field GC)[2]	Analytical (Local laboratory)[3,4]
1	Extasy Q Prints	10 borings, 2 samples per boring	PCE, TCE and DCE	TCL VOCs
2	Cabo Rojo Professional Dry Cleaners	10 borings, 2 samples per boring	PCE, TCE and DCE	TCL VOCs
3	D'Elegant Fantastic Dry Cleaners	10 borings, 2 samples per boring	PCE, TCE and DCE	TCL VOCs
4	Serrano II Dry Cleaners	10 borings, 2 samples per boring	PCE, TCE and DCE	TCL VOCs
5	PRIDCO East	10 borings, 2 samples per boring	PCE, TCE and DCE	TCL VOCs
6	PRIDCO West	20 borings, 2 samples per boring	PCE, TCE and DCE	TCL VOCs
7	RETO Plant	None (eliminated via soil vapor screening)	None	None
8	Raul Lugo	None (eliminated via soil vapor screening)	None	None
9	Unfinished Strip Mall	None (eliminated via soil vapor screening)	None	None
10	TBD A	Eliminated via reconnaissance	None	None
	Total Samples		**140**	**7**

[1] CDM Smith assumes 6 PSAs will require groundwater screening to evaluate the impact of contaminated soil on the groundwater. The actual locations will be determined based on the vapor sampling results.

[2] CDM Smith assumes duplicates at a rate of five percent.

[3] CDM Smith assumes five percent of GC samples will be sent for laboratory analysis.

[4] CDM Smith assumes that these samples will be analyzed by a local NELAP certified laboratory on 48 hour turn-around time.

Abbreviations:

DCE = dichloroethene
GC = gas chromatograph
NELAP = National Environmental Laboratory Accreditation Program
PCE = tetrachloroethene
PSA = potential source area
PRIDCO = Puerto Rico Industrial Development Company
TBD = to be determined
TCE = trichloroethene
TCL = Target Compound List
VOC = volatile organic compound

Table 3-7
Potential Source Area Soil Delineation Samples
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

No.	PSA Location[1]	Soil	Analytical (CLP/DESA)[2]
1	Extasy Q Prints	6 borings, 2 samples per boring	TCL VOCs, soil moisture, pH, TOC, grain size
2	Cabo Rojo Professional Dry Cleaners	6 borings, 2 samples per boring	TCL VOCs, soil moisture, pH, TOC, grain size
3	D'Elegant Fantastic Dry Cleaners	6 borings, 2 samples per boring	TCL VOCs, soil moisture, pH, TOC, grain size
4	Serrano II Dry Cleaners	6 borings, 2 samples per boring	TCL VOCs, soil moisture, pH, TOC, grain size
5	PRIDCO East	6 borings, 2 samples per boring	TCL VOCs, soil moisture, pH, TOC, grain size
6	PRIDCO West	6 borings, 2 samples per boring	TCL VOCs, soil moisture, pH, TOC, grain size
7	RETO Plant	None (eliminated via soil vapor screening)	None
8	Raul Lugo	None (eliminated via soil vapor screening)	None
9	Unfinished Strip Mall	None (eliminated via soil vapor screening)	None
10	TBD A	Eliminated via reconnaissance	None
	Total Samples		**72 TCL and moisture/36 pH, TOC, and GS**

[1] CDM Smith assumes 6 PSAs will require soil sampling to delineate contamination. The actual locations will be determined based on the sampling results.

[2] CDM Smith assumes that 1 sample per boring will be analyzed for soil moisture (as part of the CLP TCL VOC analyses), pH, TOC, and grain size.

Abbreviations:
CLP = Contract Laboratory Program
GS = grain size
PSA = potential source area
PRIDCO = Puerto Rico Industrial Development Company
TBD = to be determined
TOC = total organic carbon
TCL = Target Compound List
VOC = volatile organic compound

Table 3-8
Potential Source Area Overburden Monitoring Wells
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

No.	PSA Location[1]	Groundwater	Analytical - Round 1 (CLP/DESA)[2]
1	Extasy Q Prints	2 overburden wells	TCL VOCs, MNA parameters
2	Cabo Rojo Professional Dry Cleaners	2 overburden wells	TCL VOCs, MNA parameters
3	D'Elegant Fantastic Dry Cleaners	2 overburden wells	TCL VOCs, MNA parameters
4	Serrano II Dry Cleaners	2 overburden wells	TCL VOCs, MNA parameters
5	PRIDCO East	3 overburden wells	TCL VOCs, MNA parameters
6	PRIDCO West	3 overburden wells	TCL VOCs, MNA parameters
7	RETO Plant	None (eliminated via soil vapor screening)	None
8	Raul Lugo	None (eliminated via soil vapor screening)	None
9	Unfinished Strip Mall	None (eliminated via soil vapor screening)	None
10	TBD A	Eliminated via reconnaissance	None
	Total Samples		**14 TCL VOCs/5 MNA parameters**

[1] CDM Smith assumes 6 PSAs will require overburden monitoring wells. The actual locations will be determined based on the sampling results.

[2] MNA parameters will be collected from 5 overburden wells and will include: TSS, TDS, alkalinity, ammonia, hardness, TKN, chloride, MEE, nitrate/nitrite, sulfate, sulfide, TOC

Abbreviations:
CLP = Contract Laboratory Program
MEE = methane/ethene/ethane
MNA = monitored natural attenuation
PRIDCO = Puerto Rico Industrial Development Company
PSA = potential source area
TCL = Target Compound List
TDS = total dissolved solids
TKN = total Kjeldahl nitrogen
TOC = total organic carbon
TSS = total suspended solids
VOC = volatile organic compound

Table 3-9
Potential Source Area Drainage Feature Sampling
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

No.	PSA Location[1]	Surface Water	Analytical (CLP/DESA)	Sediment	Analytical (CLP/DESA)
1	Extasy Q Prints	2 samples	TCL VOCs and hardness	2 samples	TCL VOCs and TOC
2	Cabo Rojo Professional Dry Cleaners	2 samples	TCL VOCs and hardness	2 samples	TCL VOCs and TOC
3	D'Elegant Fantastic Dry Cleaners	2 samples	TCL VOCs and hardness	2 samples	TCL VOCs and TOC
4	Serrano II Dry Cleaners	2 samples	TCL VOCs and hardness	2 samples	TCL VOCs and TOC
5	PRIDCO East	3 samples	TCL VOCs and hardness	3 samples	TCL VOCs and TOC
6	PRIDCO West	3 samples	TCL VOCs and hardness	3 samples	TCL VOCs and TOC
7	RETO Plant	None (eliminated via soil vapor screening)	None	None	None
8	Raul Lugo	None (eliminated via soil vapor screening)	None	None	None
9	Unfinished Strip Mall	None (eliminated via soil vapor screening)	None	None	None
10	TBD A	Eliminated via reconnaissance	None	None	None
	Total Samples		**14**	**14**	**14**

[1] CDM Smith assume 6 PSAs will require surface water and sediment sampling to evaluate contamination. The actual locations will be determined based on PSA reconnaissance.

Abbreviations:
CLP = Contract Laboratory Program
PRIDCO = Puerto Rico Industrial Developm
PSA = potential source area
TBD = to be determined
TCL = Target Compound List
TOC = total organic carbon
VOC = volatile organic compound

Table 3-10
Analytical Summary
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

Sample Type	CLP/DESA Analysis																	Non-RAS	Field Screening							
	TCL VOC[1]	Soil Moisture[2]	Chloride	Nitrate/nitrite	Sulfate	Sulfide	TOC (aqueous)	TSS	TDS	Alkalinity	Ammonia	TOC (soil)	Hardness	pH	Grain size	MEE	TKN	TCL VOCs[3]	Field GC[4]	Ferrous Iron	pH	ORP	Temperature	Turbidity	SpC	DO
Existing Well Sampling	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GROUNDWATER	18																									
Duplicates	1																									
MS/MSD	1																									
Field Blank	2																									
Trip Blank	8																									
PSA Soil Vapor Screening	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	63	0	0	0	0	0	0	0
SOIL VAPOR																		7	60							
Duplicates																		1	3							
MS/MSD																		1								
Field Blank																		1								
Trip Blank																										
PSA Soil Screening	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	221	0	0	0	0	0	0	0
SOIL																		11	210							
Duplicates																		1	11							
MS/MSD																		1								
Field Blank																		1								
Trip Blank																										
PSA Groundwater Screening	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	147	0	0	0	0	0	0	0
GROUNDWATER																		7	140							
Duplicates																		1	7							
MS/MSD																		1								
Field Blank																		1								
Trip Blank																		1								
PSA Soil Delination Sampling	90	38	0	0	0	0	0	0	0	0	0	38	0	38	38	0	0	0	0	0	0	0	0	0	0	0
SOIL	72	36										36		36	36											
Duplicates	3	2										2		2	2											
MS/MSD	3																									
Field Blank	12																									
Trip Blank																										
Multiport Wireline Sampling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	0	0	0	0	0	0	0	0
GROUNDWATER																		30								
Duplicates																		2								
MS/MSD																		2								
Field Blank																		3								
Trip Blank																		9								
Well Sampling - Round 1[5]	61	0	22	22	22	22	22	22	22	22	22	0	22	0	0	22	22	0	0	17	44	44	44	44	44	44
GROUNDWATER	44		20	20	20	20	20	20	20	20	20		20			20	20			15	44	44	44	44	44	44
Duplicates	3		1	1	1	1	1	1	1	1	1		1			1	1			1						
MS/MSD	3		1	1	1	1	1	1	1	1	1		1			1	1			1						
Field Blank	6																									
Trip Blank	5																									
Drainage Features Sampling	22	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0
SURFACE WATER	14												14													
Duplicates	1												2													
MS/MSD	1																									
Field Blank	3																									
Trip Blank	3																									
Drainage Features Sampling	19	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEDIMENT	14											14														
Duplicates	1											2														
MS/MSD	1																									
Field Blank	3																									
Trip Blank	0																									
	222	38	22	22	22	22	22	22	22	22	22	54	38	38	38	22	22	81	431	17	44	44	44	44	44	44

Notes:

[1] SOM01.2

[2] will be part of CLP TCL analysis

[3] 48 hour turn-around time

[4] tetrachloroethene (PCE), trichloroethene (TCE) and dichloroethene (DCE)

[5] Round 1 includes 30 ports and 14 single screen wells.

Abbreviations:

DO = dissolved oxygen
GC = gas chromatograph
MEE = methane/ethane/ethene
MS/MSD = matric spike/matrix spike duplicate
ORP = oxidation reduciton potential
PSA = potential source area
SpC = specific conductivity
TCL = Target Compound List
TDS = total dissolved solids
TKN = total Kjeldahl nitrogen
TOC = total organic carbon
TSS = total suspended solids
VOC = volatile organic compound

Table 3-11
Proposed RI Report Format
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

- 1.0 Introduction
  - 1.1 Purpose of Report
  - 1.2 Site Background
    - 1.2.1 Site Description
    - 1.2.2 Site History
    - 1.2.3 Previous Investigations
  - 1.3 Report Organization
- 2.0 Study Area Investigation
  - 2.1 Surface Features
  - 2.2 Contaminant Source Investigations
  - 2.3 Meteorological Investigations
  - 2.4 Surface Water and Sediment Investigations
  - 2.5 Geological Investigations
  - 2.6 Soil and Vadose Zone Investigation
  - 2.7 Groundwater Investigation
  - 2.8 Human Population Surveys
  - 2.9 Ecologic Investigation
- 3.0 Physical Characteristics of Site
  - 3.1 Topography
  - 3.2 Meteorology
  - 3.3 Surface Water and Sediment
  - 3.4 Geology
  - 3.5 Hydrogeology
  - 3.6 Soils
  - 3.7 Demographics and Land Use
- 4.0 Nature and Extent of Contamination
  - 4.1 Sources of Contamination
  - 4.2 Soils
  - 4.3 Groundwater
  - 4.4 Surface Water and Sediments
- 5.0 Contaminant Fate and Transport
  - 5.1 Routes of Migration
  - 5.2 Contaminant Persistence
  - 5.3 Contaminant Migration
- 6.0 Baseline Risk Assessment (If conducted, submitted separately from RI report)
- 7.0 Screening Level Ecological Risk Assessment (if conducted, submitted separately from RI report)
- 8.0 Summary and Conclusions
  - 7.1 Source(s) of Contamination
  - 7.2 Nature and Extent of Contamination
  - 7.3 Fate and Transport
  - 7.4 Risk Assessment
  - 7.5 Data Limitations and Recommendations for Future Work
  - 7.6 Recommended Remedial Action Objectives

Appendices: Boring Logs, Hydrogeologic Data, Analytical Data/QA/QC Evaluation

Table 3-12
Detailed Evaluation Criteria for Remedial Alternatives
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

- OVERALL PROTECTION OF HUMAN HEALTH AND ENVIRONMENT

- COMPLIANCE WITH ARARs
  - Compliance with chemical-specific ARARs
  - Compliance with action-specific ARARs
  - Compliance with location-specific ARARs
  - Compliance with appropriate criteria, advisories and guidance

- LONG-TERM EFFECTIVENESS
  - Magnitude of risk remaining at the site after the response objectives have been met
  - Adequacy of controls
  - Reliability of controls

- REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT
  - Treatment process and remedy
  - Amount of hazardous material destroyed or treated
  - Reduction in toxicity, mobility or volume of the contaminants
  - Irreversibility of the treatment
  - Type and quantity of treatment residuals

- SHORT-TERM EFFECTIVENESS
  - Protection of community during remedial action
  - Protection of workers during remedial actions
  - Time until remedial response objectives are achieved
  - Environmental impacts

- IMPLEMENTABILITY
  - Ability to construct technology
  - Reliability of technology
  - Ease of undertaking additional remedial action, if necessary
  - Monitoring considerations
  - Coordination with other agencies
  - Availability of treatment, storage capacity, and disposal services
  - Availability of necessary equipment and specialists
  - Availability of prospective technologies

- COST
  - Capital costs
  - Annual operating and maintenance costs
  - Present worth
  - Sensitivity Analysis

- COMMONWEALTH ACCEPTANCE

- COMMUNITY ACCEPTANCE

Table 3-13
Proposed Feasibility Study Report Format
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

1.0 Introduction
- 1.1 Purpose and Organization of Report
- 1.2 Site Description and History
- 1.3 Summary of the Remedial Investigation
- 1.4 Physical Characteristics of the Study Area
- 1.5 Nature and Extent of Contamination
- 1.6 Contaminant Fate and Transport and Conceptual Site Model
- 1.7 Baseline Risk Assessment

2.0 Identification and Screening of Technologies
- 2.1 Identification of Remedial Action Objectives
  - Contaminants of Interest
  - Allowable Exposure Based on Risk Assessment
  - Allowable Exposure Based on ARARs
  - Development of Remedial Action Objectives
- 2.2 Potential ARARs, Guidelines, and Other Criteria
  - Chemical-specific ARARs and TBCs
  - Location-specific ARARs
  - Action-specific ARAs and TBCs
- 2.3 Preliminary Remediation Goals
- 2.2 General Response Actions for Each Medium
  - No Action
  - Technologies
- 2.3 Identification and Screening of Remedial Technologies and Process Options
  - 2.3.1 Description of Technologies
  - 2.3.2 Screening of Technologies

3.0 Development of Remedial Alternatives
- 3.1 Assumptions
- 3.2 Description of Remedial Alternatives
  - 3.2.1 Elements Common to all Alternatives
  - 3.2.2 Alternative 1
- 3.3 Screening of Alternatives
  - 3.3.1 Alternative 1

4.0 Detailed Analysis of Alternatives
- 4.1 Description of Evaluation Criteria
  - Short-Term Effectiveness
  - Long-Term Effectiveness and Permanence
  - Implementability
  - Reduction of Mobility, Toxicity, or Volume Through Treatment
  - Compliance with ARARs
  - Overall Protection
  - Cost
  - State Acceptance
  - Community Acceptance
- 4.2 Individual Analysis of Alternatives
- 4.3 Summary

5.0 Comparative Analysis of Alternatives
- 5.1 Comparison Among Alternatives For Each Medium

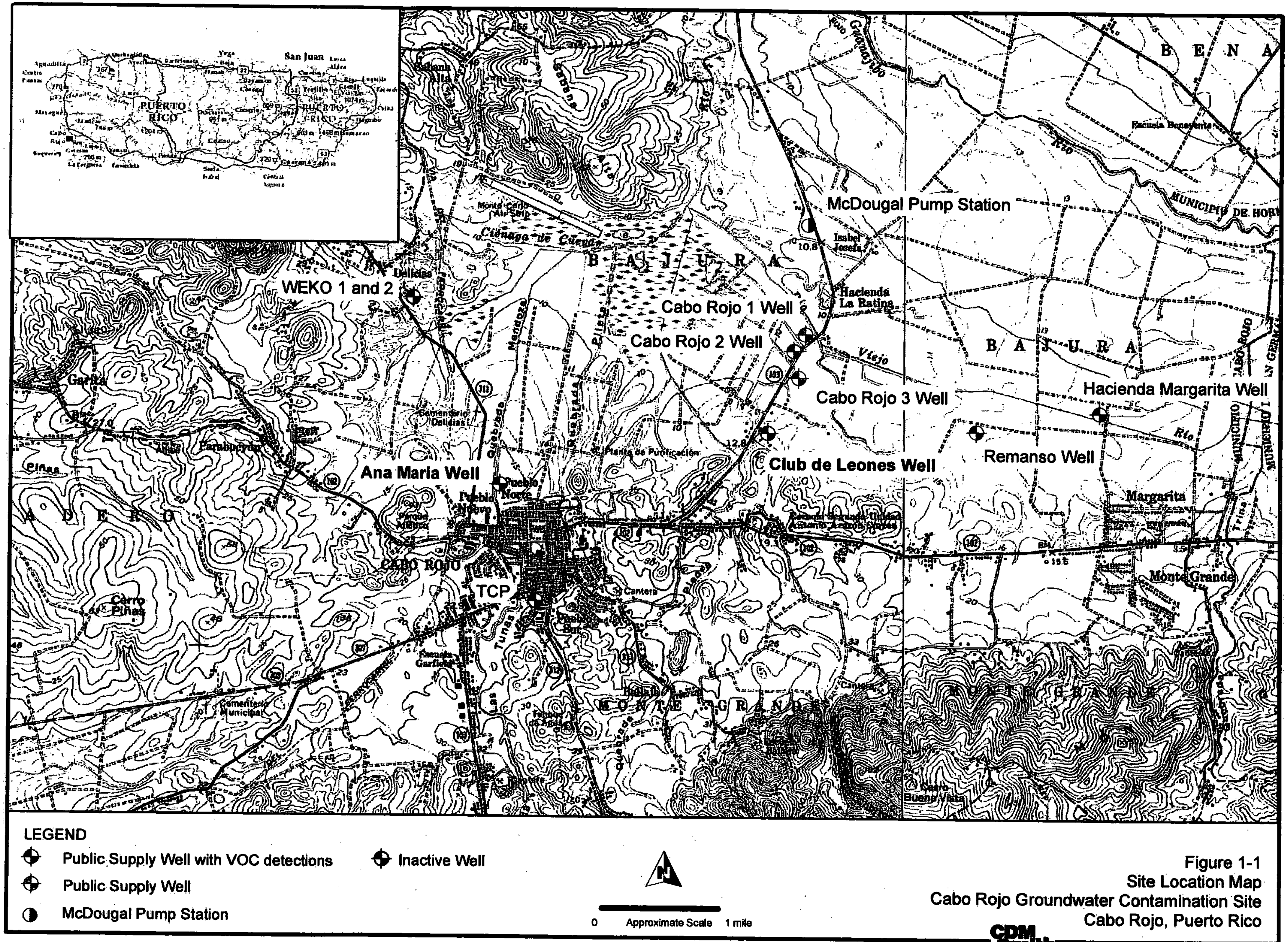

Figure 1-1
Site Location Map
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

CDM Smith

Legend

- Cabo Rojo Public Supply Wells
- Cabo Rojo Urbano Public Supply Wells with Volatile Organic Compounds Detections
- Pump Station Location
- Potential Sources of Groundwater Contamination
- Inactive well

Figure 1-2
Site Map
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

CDM Smith

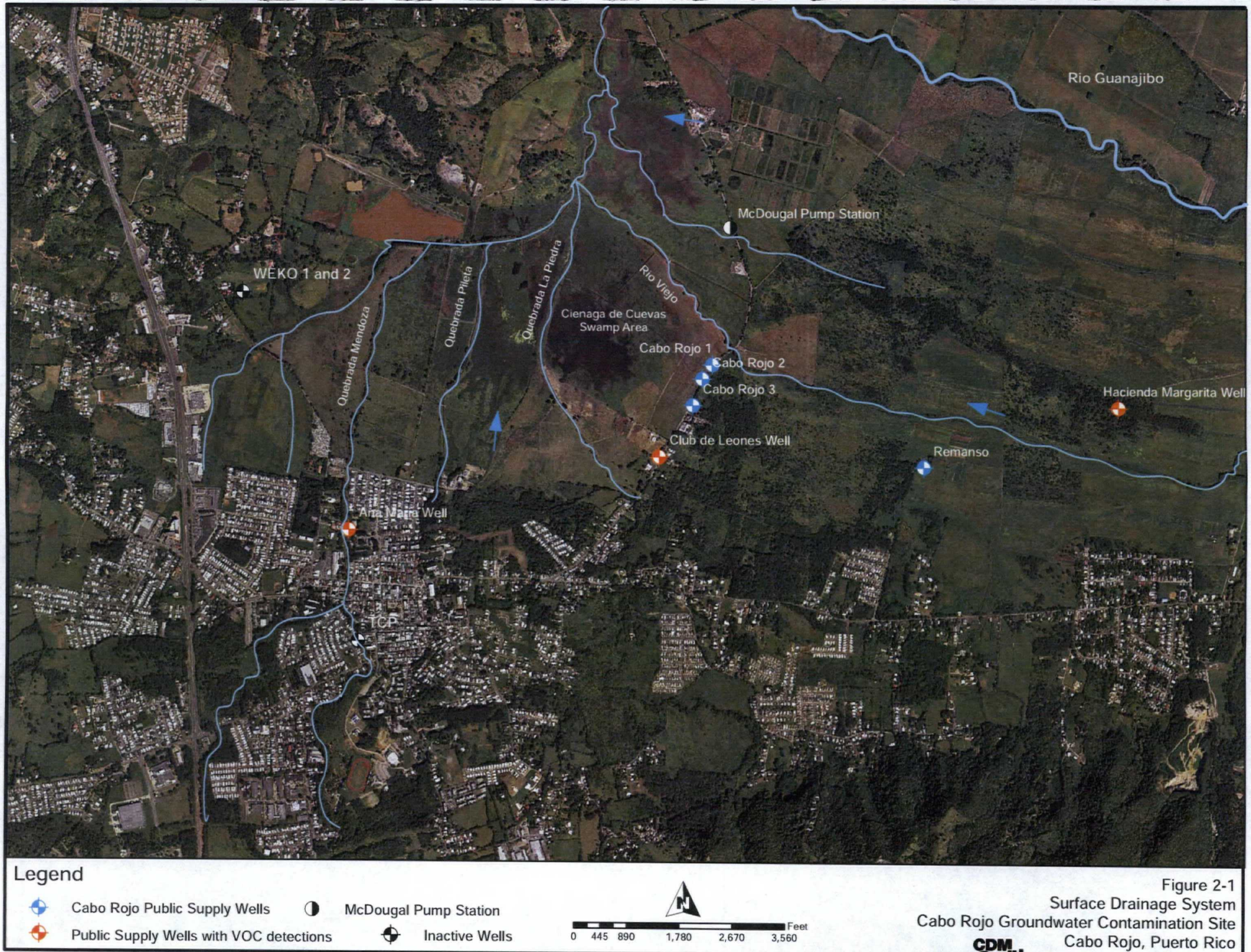

Figure 2-1
Surface Drainage System
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

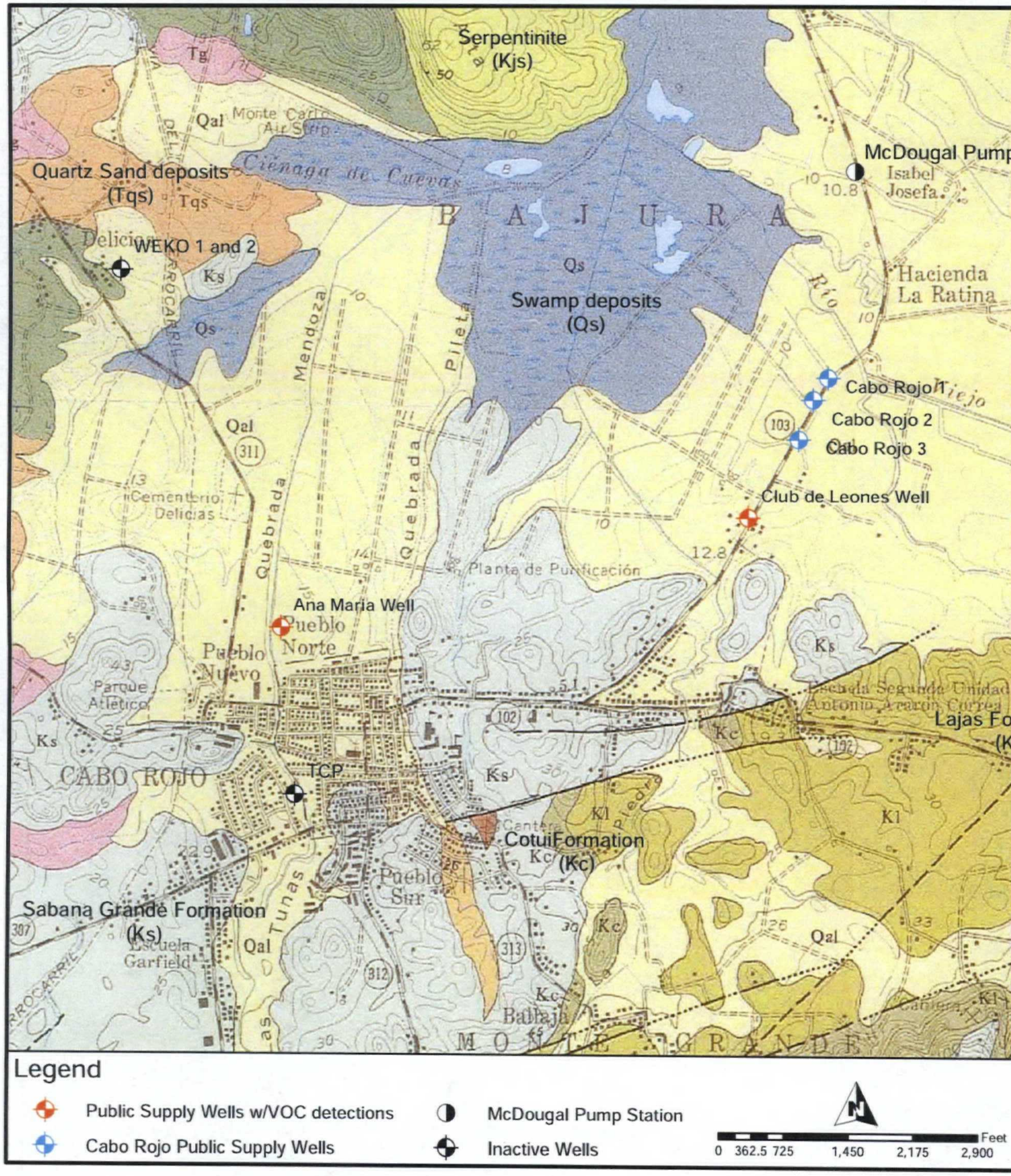

Figure 2-2
Site Geologic Map
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

CDM Smith

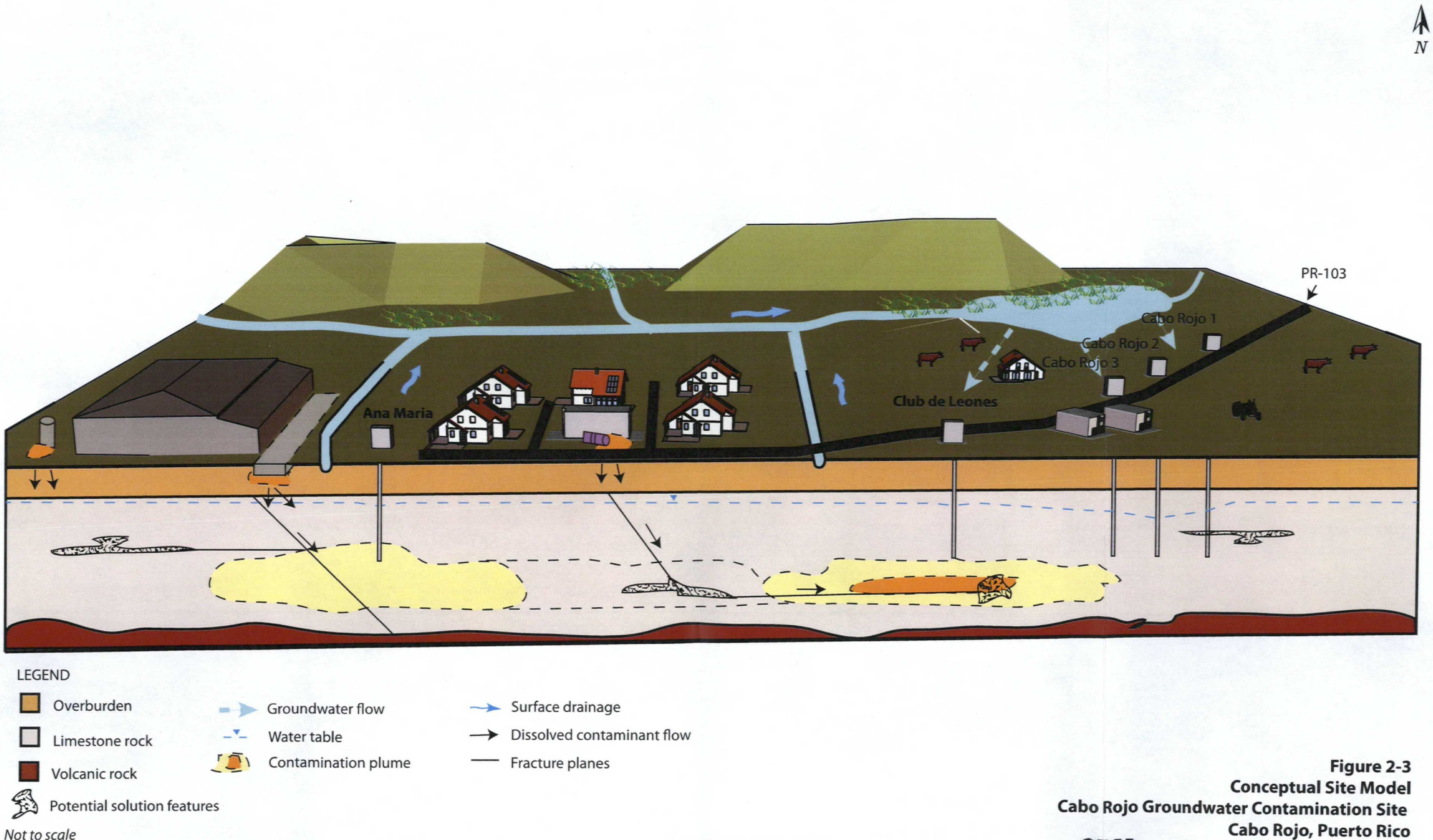

Figure 2-3
Conceptual Site Model
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

CDM Smith

Legend

Public Supply Wells w/VOC detections
Cabo Rojo Public Supply Wells
Inactive Wells
Potential Source Area Location*
Pump Station Location

0 4,000 Feet

* Additional locations would be identified during the site reconnaissance and as site information becomes available.

Figure 3-1
Proposed Potential Sorce Area Investigation Locations
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

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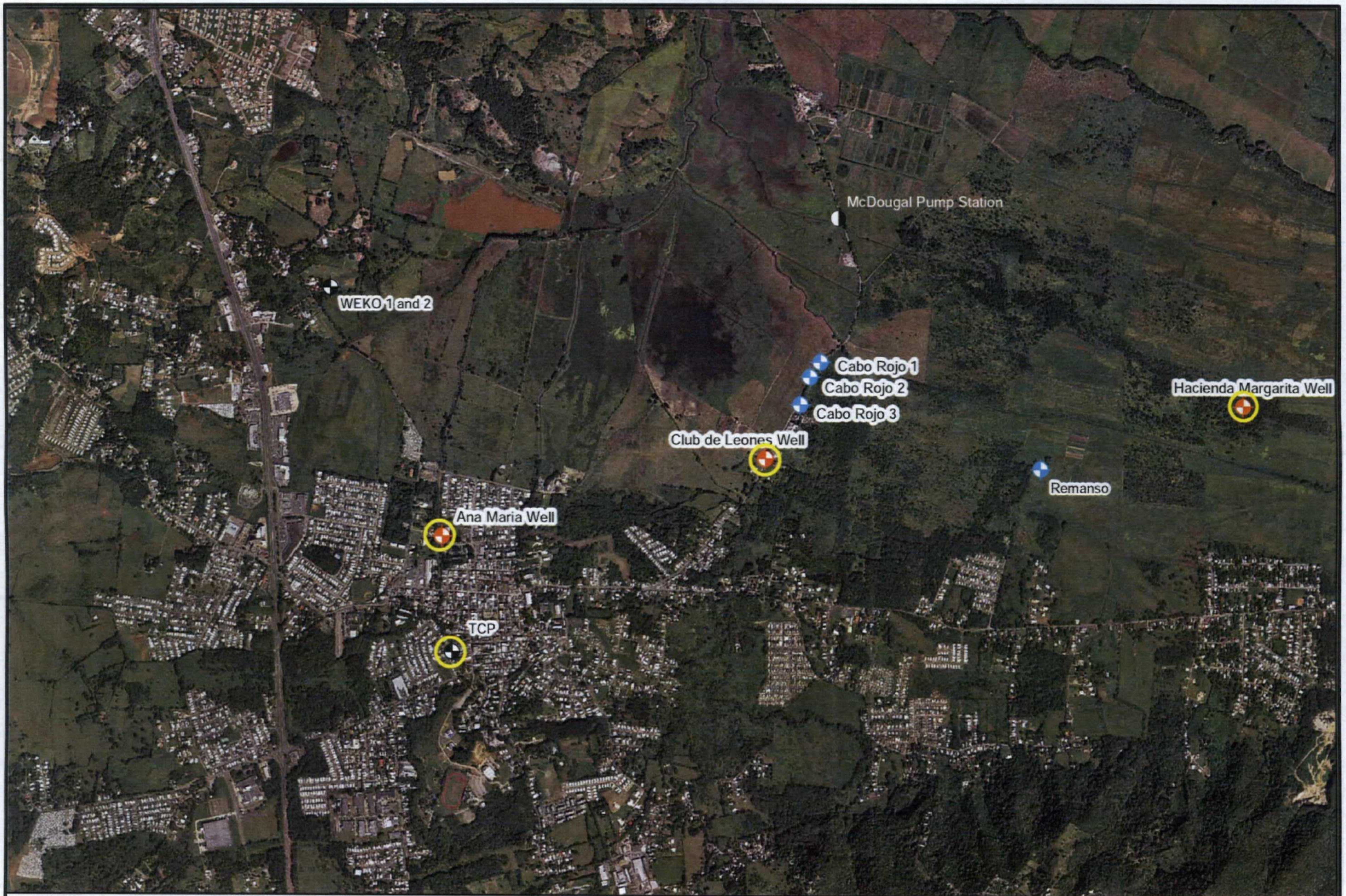

Legend

- Public Supply Wells
- Pump Station Location
- Inactive Wells
- Geophysical Logging and Well Evaluation Location *
- Public Supply Wells w/VOC detections

0 — 4,000 Feet

* Additional locations would be identified during the site reconnaissance and as site information becomes available.

Figure 3-2
Proposed Geophysical logging and Well Evaluation Location
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

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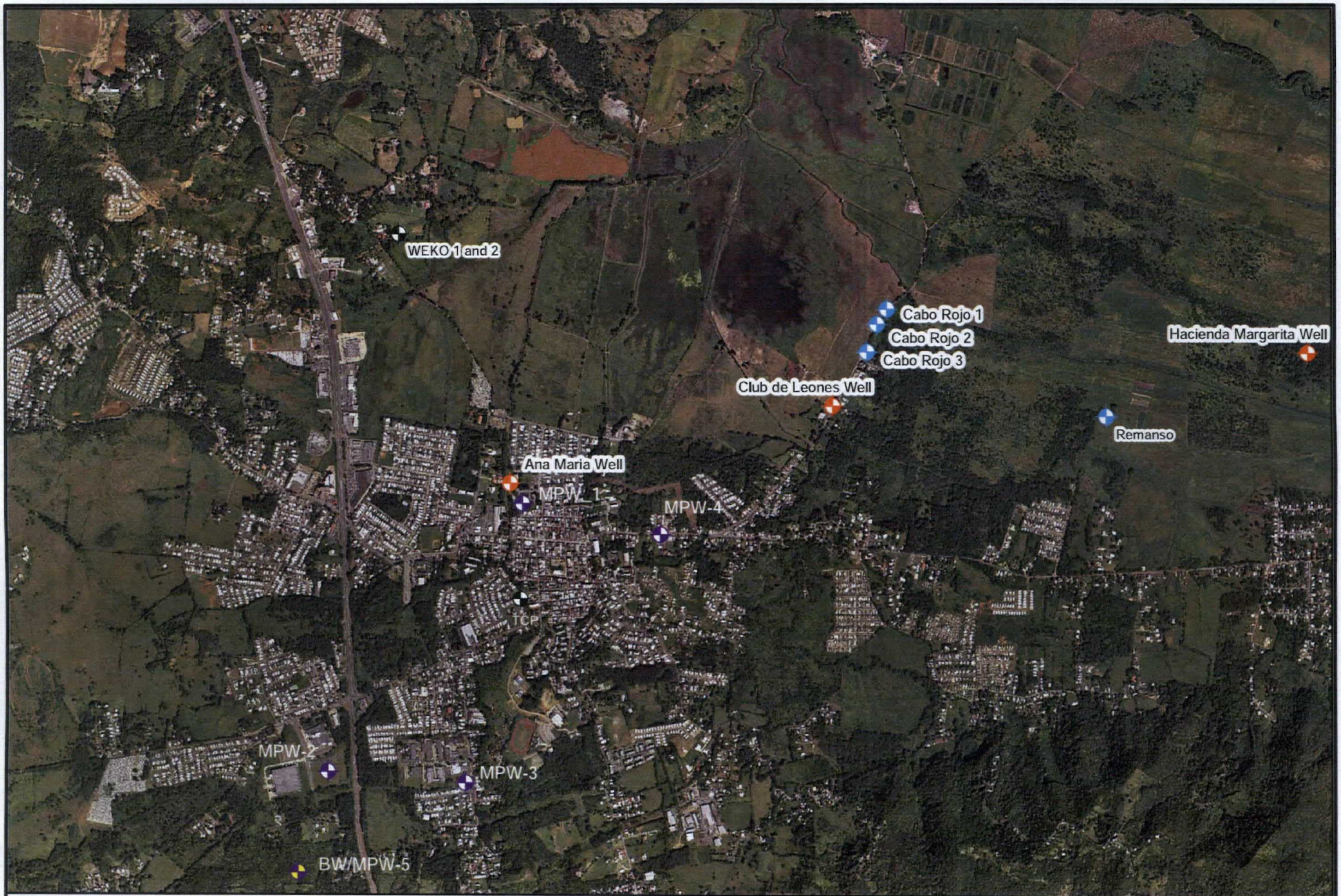

Legend

- Public Supply Wells
- Public Supply Wells
- Inactive Wells
- Multiport Well Location*
- Background/Miltiport Well Location

* Additional locations would be identified during site reconnaissance and as site information becomes available.

0 4,000 Feet

Figure 3-3
Proposed Multiport and Background Well Locations
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

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Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Exposure Medium	Potential Exposure Route	Current Receptor: POTENTIAL SOURCE AREAS* Worker (Adults)	Current: POTENTIAL SOURCE AREAS* Trespasser (Adolescents)	Current: OFFSITE Worker (Adults)	Current: OFFSITE Farmer (Adults)	Current: OFFSITE Resident (Adults and Young Children)	Current: OFFSITE School Staff and Students (Adults, Adolescents, Children, and Young Children)	Future Receptor: POTENTIAL SOURCE AREAS* Worker (Adults)	Future: POTENTIAL SOURCE AREAS* Resident (Adults and Young Children)	Future: POTENTIAL SOURCE AREAS* Construction Worker (Adults)	Future: POTENTIAL SOURCE AREAS* Trespasser (Adolescents)	Future: OFFSITE Worker (Adults)	Future: OFFSITE Farmer (Adults)	Future: OFFSITE Resident (Adults and Young Children)	Future: OFFSITE School Staff and Students (Adults, Adolescents, Children, and Young Children)
Potential Source Areas*	Spills/Releases	Surface Soil		Surface Soil	Dermal	●	●	○	○	○	○	●	●	●	●	○	○	○	○
					Ingestion	●	●	○	○	○	○	●	●	●	●	○	○	○	○
					Inhalation	●	●	○	○	○	○	●	●	●	●	○	○	○	○
		Subsurface Soil		Subsurface Soil	Dermal	○	○	○	○	○	○	○	○	●	○	○	○	○	○
					Ingestion	○	○	○	○	○	○	○	○	●	○	○	○	○	○
					Inhalation	○	○	○	○	○	○	○	○	●	○	○	○	○	○
		Subsurface Soil / Groundwater	Volatilization/ Diffusion/ Convection	Indoor Air	Inhalation	●	○	●	●	●	●	●	●	○	○	●	●	●	●
		Groundwater		Groundwater	Dermal	●	○	●	●	○	○	○	●	○	○	○	●	●	○
					Ingestion	○	○	○	○	○	○	●	●	○	○	●	●	●	●
					Inhalation	●	○	●	●	○	○	○	●	○	○	○	●	●	○

*Potential source areas currently include Cabo Rojo Professional Dry Cleaner, Extasy Q Prints, D'Elegant Fantastic Dry Cleaners, Lifescan, Cutler Hammer, PRIDCO Complex, Reto Plant 1, Raul Lugo Storage, and WR Recycling. Each potential source area may be evaluated separately.

Age Group: Adolescents 12-18 years old; Children 6-12 years old; Young Children 0-6 years old

Legend:

● complete exposure pathway

○ incomplete/insignificant exposure pathway

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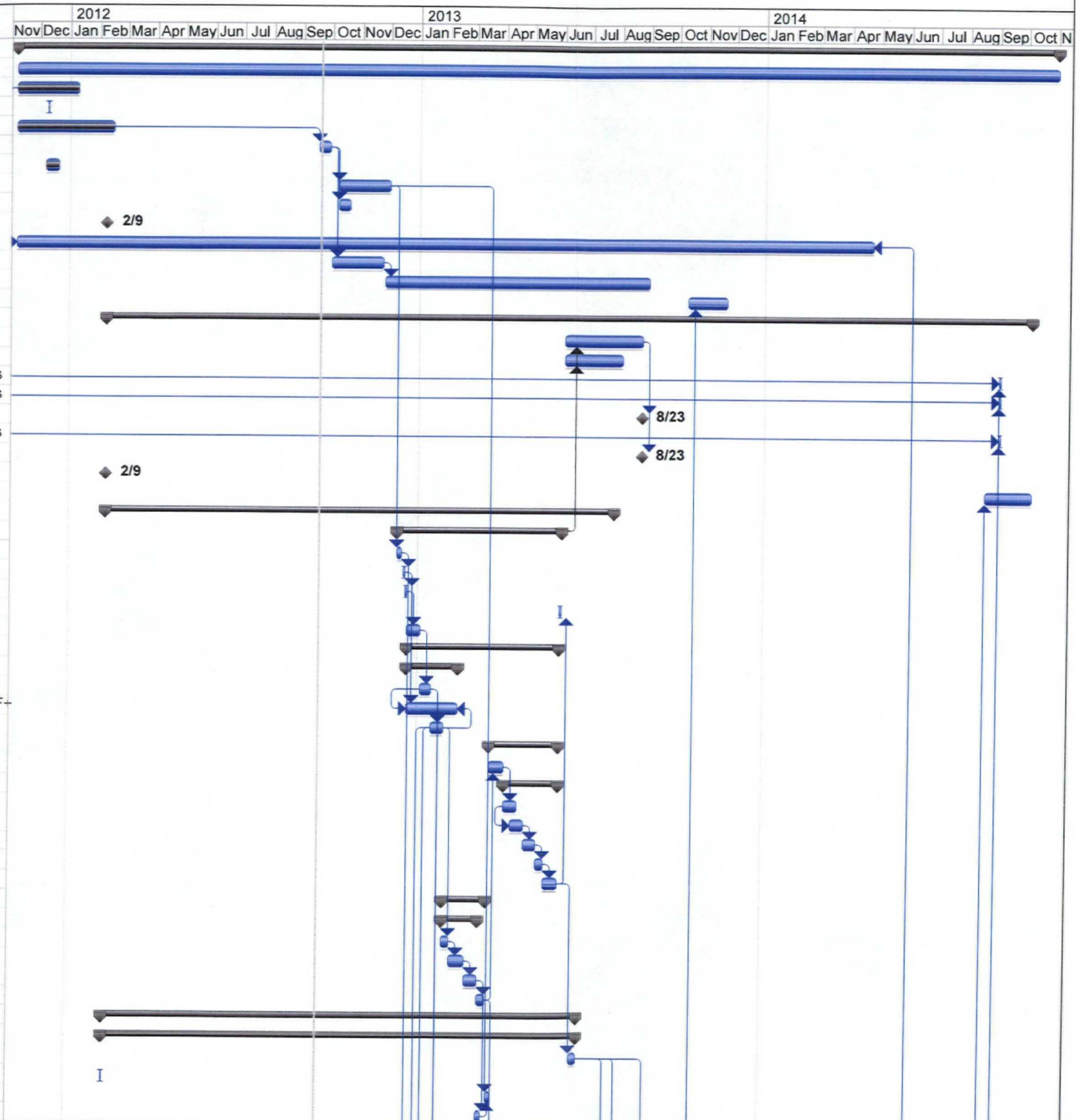
Figure 3-4
Preliminary Conceptual Site Model
Human Health Risk Assessment
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

Figure 4-1
Proposed Project Schedule
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

ID		Task Name	Subtask	Duration	Start	Finish	Predecessors
1		**Task 1 Project Planning and Support**		**780 days**	**Mon 11/7/11**	**Fri 10/31/14**	
2		Project Administration	1.1	780 days	Mon 11/7/11	Fri 10/31/14	
3	✓	Attend Scoping Meeting	1.2	46 days	Mon 11/7/11	Mon 1/9/12	
4	✓	Conduct Site Visit	1.3	1 day	Fri 12/9/11	Fri 12/9/11	
5	✓	Develop Draft Work Plan and Associated Cost Estimate	1.4	73 days	Mon 11/7/11	Wed 2/15/12	
6		Negotiate and Finalize Draft Work Plan/Budget	1.5	10 days	Mon 9/17/12	Fri 9/28/12	5FS+152 days
7	✓	Evaluate Existing Data and Documents	1.6	10 days	Wed 12/7/11	Tue 12/20/11	
8		Quality Assurance Project Plan	1.7	40 days	Mon 10/8/12	Fri 11/30/12	6FS+5 days
9		Health and Safety Plan	1.8	10 days	Mon 10/8/12	Fri 10/19/12	6FS+5 days
10		Non-RAS Analysis	1.9	0 days	Thu 2/9/12	Thu 2/9/12	
11		Meetings	1.10	643 days	Mon 11/7/11	Wed 4/23/14	3SS,92FF
12		Subcontract Procurement	1.11	40 days	Mon 10/1/12	Fri 11/23/12	6
13		Subcontract Management	1.12	200 days	Mon 11/26/12	Fri 8/30/13	12
14		Pathway Analysis Report	1.13	6 wks	Fri 10/11/13	Thu 11/21/13	72
15		**Task 2 Community Involvement**		**693 days**	**Thu 2/9/12**	**Mon 10/6/14**	
16		Community Interviews	2.1	60 days	Mon 6/3/13	Fri 8/23/13	26
17		Community Involvement Plan	2.2	45 days	Mon 6/3/13	Fri 8/2/13	26
18		Public Meeting Support	2.3	2 days	Tue 9/2/14	Wed 9/3/14	3SS,93FS+8 wks
19		Fact Sheet Preparation	2.4	2 days	Tue 9/2/14	Wed 9/3/14	3SS,93FS+8 wks
20		Proposed Plan Support	2.5	0 days	Fri 8/23/13	Fri 8/23/13	16
21		Public Notices	2.6	2 days	Tue 9/2/14	Wed 9/3/14	3SS,93FS+8 wks
22		Information Repositories	2.7	0 days	Fri 8/23/13	Fri 8/23/13	16
23		Site Mailing List	2.8	0 days	Thu 2/9/12	Thu 2/9/12	
24		Reponsiveness Summary Report	2.9	35 days	Tue 8/19/14	Mon 10/6/14	93FS+6 wks
25		**Task 3 Field Investigation**		**381 days?**	**Thu 2/9/12**	**Thu 7/25/13**	
26		**Site Reconnaissance**	**3.1**	**125 days**	**Mon 12/10/12**	**Fri 5/31/13**	
27		Potential Source Area Reconnaissance	3.1.1	5 days	Mon 12/10/12	Fri 12/14/12	8FS+5 days
28		Existing Well Reconnaissance	3.1.2	2 days	Mon 12/17/12	Tue 12/18/12	27
29		Cultural Resources Survey Oversight	3.1.3	2 days	Wed 12/19/12	Thu 12/20/12	28
30		Topographic Survey Oversight	3.1.4	2 days	Thu 5/30/13	Fri 5/31/13	44
31		Mobilization and Demobilization	3.2	2 wks	Fri 12/21/12	Thu 1/3/13	29
32		**Hydrogeological Assessment**	**3.3**	**114 days**	**Fri 12/21/12**	**Wed 5/29/13**	
33		**Existing Well Evaluation**	**3.3.1**	**38 days**	**Fri 12/21/12**	**Tue 2/12/13**	
34		Downhole Geophysics of Existing Wells	3.3.1.1	8 days	Fri 1/4/13	Tue 1/15/13	31
35		Continuous Water Level Monitoring	3.3.1.2	38 days	Fri 12/21/12	Tue 2/12/13	34SS-2 wks,36FF+
36		Wireline Fracture Zone Groundwater Sampling	3.3.1.3	9 days	Wed 1/16/13	Mon 1/28/13	34
37		**Monitoring Well Installation**	**3.3.2**	**53 days**	**Mon 3/18/13**	**Wed 5/29/13**	
38		Overburden Monitoring Well Installation	3.3.2.1	12 days	Mon 3/18/13	Tue 4/2/13	50
39		**Multiport Well Installation**	**3.3.2.2**	**41 days**	**Wed 4/3/13**	**Wed 5/29/13**	
40		Borehole Drilling	3.3.2.2.1	10 days	Wed 4/3/13	Tue 4/16/13	38
41		Borehole Geophysics	3.3.2.2.2	10 days	Wed 4/10/13	Tue 4/23/13	40SS+1 wk
42		Wireline Fracture Zone Sampling	3.3.2.2.3	9 days	Wed 4/24/13	Mon 5/6/13	41
43		Borehole Hydraulic Conductivity Profiling	3.3.2.2.4	6 days	Tue 5/7/13	Tue 5/14/13	42
44		Multiport Monitoring Well Installation	3.3.2.2.5	11 days	Wed 5/15/13	Wed 5/29/13	43
45		**Soil Boring Drilling and Testing**	**3.4**	**34 days**	**Tue 1/29/13**	**Fri 3/15/13**	
46		**Potential Source Area Investigations**	**3.4.1**	**28 days**	**Tue 1/29/13**	**Thu 3/7/13**	
47		Soil Gas Screening	3.4.1.1	6 days	Tue 1/29/13	Tue 2/5/13	36
48		Soil Screening	3.1.4.2	12 days	Wed 2/6/13	Thu 2/21/13	47
49		Groundwater Screening	3.1.4.3	10 days	Fri 2/22/13	Thu 3/7/13	48
50		Source Area Soil Delineation Borings	3.4.2	6 days	Fri 3/8/13	Fri 3/15/13	49
51		**Environmental Sampling**	**3.5**	**356 days?**	**Thu 2/9/12**	**Thu 6/20/13**	
52		**Groundwater Sampling**	**3.5.1**	**356 days?**	**Thu 2/9/12**	**Thu 6/20/13**	
53		Groundwater Sampling Round 1	3.5.1.1	6 days	Thu 6/13/13	Thu 6/20/13	44FS+10 days
54				1 day?	Thu 2/9/12	Thu 2/9/12	
58		Wetlands Sampling	3.5.2	5 days	Mon 3/18/13	Fri 3/22/13	8,56
56		Drainage Feature Sampling	3.5.3	3 days	Fri 3/8/13	Tue 3/12/13	49

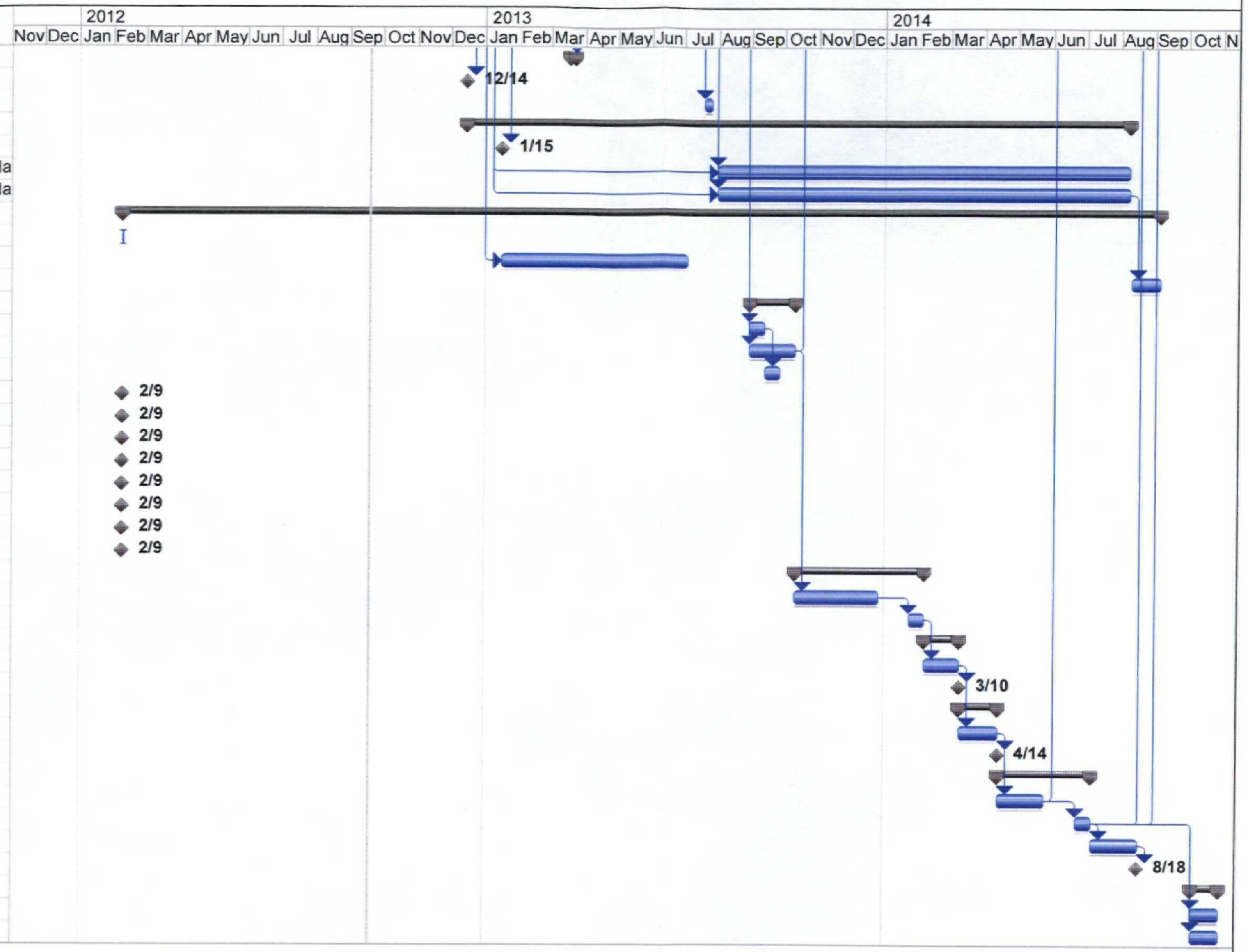


Project: Cabo_Rojo_Schedule 201209
Date: Wed 9/19/12

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Figure 4-1
Proposed Project Schedule
Cabo Rojo Groundwater Contamination Site
Cabo Rojo, Puerto Rico

ID	Task Name	Subtask	Duration	Start	Finish	Predecessors
57	**Ecological Characterization**	**3.6**	**5 days**	**Mon 3/18/13**	**Fri 3/22/13**	**50**
61	Geotechnical Survey	3.7	0 days	Fri 12/14/12	Fri 12/14/12	27
59	Investigation Derived Waste	3.8	5 days	Fri 7/19/13	Thu 7/25/13	53FS+4 wks
60	**Task 4 Sample Analytis**		**430 days**	**Fri 12/14/12**	**Fri 8/8/14**	
62	Innovative Methods/Field Screening Sample Analysis	4.1	0 days	Tue 1/15/13	Tue 1/15/13	34
63	Analytical Services Provided by CLP, DESA or EPA-ERT	4.2	268 days	Wed 7/31/13	Fri 8/8/14	36SS,53FS+28 da
64	Non-Routine Analytical Services	4.3	268 days	Wed 7/31/13	Fri 8/8/14	36SS,53FS+28 da
65	**Task 5 Analytical Support and Data Validation**		**672 days?**	**Thu 2/9/12**	**Fri 9/5/14**	
68	Prepare and Ship Samples	5.1	1 day?	Thu 2/9/12	Thu 2/9/12	
69	Sample Management	5.2	121 days	Wed 1/16/13	Wed 7/3/13	36SS
67	Data Validation	5.3	4 wks	Mon 8/11/14	Fri 9/5/14	64
70	**Task 6 Data Evaluation**		**30 days**	**Fri 8/30/13**	**Thu 10/10/13**	
71	Data Usability Evaluation	6.1	10 days	Fri 8/30/13	Thu 9/12/13	53FS+10 wks
72	Data Reduction, Tabulation and Evaluation	6.2	30 days	Fri 8/30/13	Thu 10/10/13	53FS+10 wks
73	Modeling - OPTIONAL	6.3	10 days	Fri 9/13/13	Thu 9/26/13	71
74	**Task 7 Risk Assessment**		**0 days**	**Thu 2/9/12**	**Thu 2/9/12**	
75	Baseline Risk Assessment (Human Health) - OPTIONAL	7.1	0 days	Thu 2/9/12	Thu 2/9/12	
76	Screening Level Ecological Risk Assessment - OPTIONAL	7.2	0 days	Thu 2/9/12	Thu 2/9/12	
77	**Task 8 Treatibility Study and Pilot Testing**		**0 days**	**Thu 2/9/12**	**Thu 2/9/12**	
78	Literature Search	8.1	0 wks	Thu 2/9/12	Thu 2/9/12	
79	Treatibility Study Work Plan - OPTIONAL	8.2	0 days	Thu 2/9/12	Thu 2/9/12	
80	Conduct Treatibility Studies - OPTIONAL	8.3	0 days	Thu 2/9/12	Thu 2/9/12	
81	Treatibility Study Report - OPTIONAL	8.4	0 days	Thu 2/9/12	Thu 2/9/12	
82	**Task 9 Remedial Investigation Report**		**85 days**	**Fri 10/11/13**	**Thu 2/6/14**	
83	Draft Remedial Investigation Report	9.1	11 wks	Fri 10/11/13	Thu 12/26/13	72
84	Final Remedial Investigation Report	9.2	10 days	Fri 1/24/14	Thu 2/6/14	83FS+4 wks
85	**Task 10 Remedial Alternatives Screening**		**22 days**	**Fri 2/7/14**	**Mon 3/10/14**	
86	Draft Technical Memorandum	10.1	22 days	Fri 2/7/14	Mon 3/10/14	84
87	Final Technical Memorandum	10.2	0 days	Mon 3/10/14	Mon 3/10/14	86
88	**Task 11 Remedial Alternatives Evaluation**		**25 days**	**Tue 3/11/14**	**Mon 4/14/14**	
89	Draft Technical Memorandum	11.1	25 days	Tue 3/11/14	Mon 4/14/14	86
90	Final Technical Memorandum	11.2	0 days	Mon 4/14/14	Mon 4/14/14	89
91	**Task 12 Feasibility Study**		**60 days**	**Tue 4/15/14**	**Mon 7/7/14**	
92	Draft Feasibility Study Report	12.1	30 days	Tue 4/15/14	Mon 5/26/14	89
93	Final Feasibility Study Report	12.2	10 days	Tue 6/24/14	Mon 7/7/14	92FS+4 wks
94	**Task 13 Post RI/FS Support - OPTIONAL**		30 days	Tue 7/8/14	Mon 8/18/14	93
95	**Task 14 Administrative Record**		0 days	Mon 8/18/14	Mon 8/18/14	94
96	**Task 15 Work Assignment Closeout**		**19 days**	**Tue 10/7/14**	**Fri 10/31/14**	
97	Document Indexing	15.1	19 days	Tue 10/7/14	Fri 10/31/14	93FS+13 wks
98	Document Retention/Conversion	15.2	19 days	Tue 10/7/14	Fri 10/31/14	93FS+13 wks



Project: Cabo_Rojo_Schedule 201209 Date: Wed 9/19/12	Task		Progress		Summary		External Tasks	Deadline
	Split		Milestone	◆	Project Summary		External Milestone ◆	